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The Salamanders and Caecilians of Costa Rica

BY

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ABSTRACT: The known caecilians and salamanders of Costa Rica are treated in this paper. The caecilians (*Gymnophiona*) are represented by two genera and three forms (species and subspecies). The salamanders are represented by six genera and twenty-seven species. In the latter group the following are described as new: *Magnadigita pesrubra*, *Magnadigita torresi*, *Magnadigita cerroensis*, *Oedipina bonitaensis*, *Oedipina cyclocauda*, *Oedipina longissima*, *Oedipina gracilis*, *Oedipina pacificensis* and *Oedipina inusitata*.

The salamander fauna is obviously an impoverished one, since, of the four families and eighteen genera occurring in Mexico, only one family and five genera reach Costa Rica. A single endemic genus, *Haptoglossa*, is known.

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INTRODUCTION

In the spring of 1947, I received an invitation from the Director of the National University of Costa Rica to spend the summer in Costa Rica studying the herpetological faunas of the country. It was hoped that one result from the journey would be the preparation of a publication that might serve as a taxonomic aid in the further study of the rich fauna of the country. I accepted the invitation with alacrity and was ready to leave on June 18. I was joined at this time by Richard C. Taylor, likewise interested in making a herpetological collection.

After an uneventful journey by air and a short delay in obtaining necessary permits, we found ourselves ready to begin our collecting on June 24. From this date until September 7, the greater part of our time was spent in the field.

Together we sampled the faunas in four principal areas. These were: the general area about Turrialba and the farm of the Inter-American Institute of Agriculture; the region about the American Cinchona Plantation at Isla Bonita on the eastern slope of Volcán Poás; the summit and western slope of the high peak, Cerro de la Muerte, in the Cordillera de Talamanca; and the lowland area north-east of Volcán Turrialba, at Los Diamantes.

Several subsidiary localities were visited and a few forms not found in the four major areas were acquired. For greater details of the journey and collecting, see my article, "A Brief Review of the Snakes of Costa Rica." Univ. Kansas Sci. Bull., vol. 34, pt. 1, 1951, pp. 1-188.

I wish especially to acknowledge my appreciation to my official host, Prof. Reubén Torres Rojas who contributed much to the success of my journey; and to Dr. Ralph H. Allee, the Director of the Inter-American Institute of Agriculture at Turrialba who permitted us to make the place our headquarters, and to use the facilities of the Institute to further our work.

A number of other persons helped us in many ways, among whom are: Dr. Fernando Baudrit, Rector of the University; Dr. Frederick Wellman, Mr. James Forman, Mr. David Allee, of the Inter-American Institute of Agriculture; Captain Hope, Mr. Deal Thornton, of the American Cinchona Plantation; Mr. Virgil Cave of the Pan-American Highways; Prof. Marco Tullio Pacheco of the National Museum; and Mr. Wallace E. Manis, Director of the rubber plantation at Los Diamantes.

The study here presented is based chiefly on the collections obtained by me together with those made by Richard C. Taylor, who has kindly placed his material at my disposal for study.

HISTORY OF LITERATURE AND COLLECTIONS

The first salamander to be described from Costa Rica was *Oedipina uniformis* Keferstein (1868). It was based on a specimen collected by von Seebach, and presumably lacking specific locality data. Almost at the same time another species was described as *Opheobatrachus vermicularis* Gray (1868), a species likewise without specific locality data. Certain subsequent workers have regarded the two species as synonymous; nevertheless, there is considerable evidence that such is not the case, and that two species are concerned. However, they are congeneric and the older generic name (by a few weeks only) is *Oedipina*.

The report by Edward D. Cope (1875) on the William Gabb herpetological collection made in the southeastern part of the country and on Pico Blanco, contains mention of one caecilian and two species of salamanders. These are listed as follows: *Siphonops mexicanus* Duméril and Bibron, from "near the coast at Limón"; *Opheobatrachus vermicularis* Gray, three specimens, one specimen from Pico Blanco, 6000 ft., and "two other specimens are from the lower country twenty miles from the coast"; and *Oedipus*

morio? "a partly preserved specimen" from the eastern slope of Pico Blanco. It is surprising that the caecilians and salamanders in this early collection, so rich in reptiles and other amphibians, should have been so meagerly represented.

In 1877 Cope reported two new species of caecilians, *Siphonops proximus* and *Siphonops sinus*, each lacking specific locality data. The first was collected by William M. Gabb; the second was sent by Dr. von Frantzius who may or may not have been the collector. Later (1879) Cope reported a specimen of *Oedipus morio* from Cartago, collected by Don José Zeledón (he had previously [1875] listed this species with a question). In 1894 he described from a single specimen the large species *Oedipus robustus* "from the Faldas of the volcano Irazu, from J. P. Cooper." He states that he is indebted to the Museo Nacional of San José for the opportunity of examining the described material.

Dr. George A. Boulenger (1896) described *Spelerpes subpalmatus*, from La Palma. This specimen was included in the herpetological collections made for the British Museum by Mr. C. F. Underwood.

No further new species were described until 1911, when Dr. Leonhard Stejneger described as new a small salamander from La Estrella, southeast of Cartago, under the name *Spelerpes picadoi*. The types were collected by Sr. C. Picado T., and presented to the U. S. National Museum.

In a work, treating of a collection from Nicaragua, Dr. Gladwin K. Noble (1918) described a new species of salamander, *Oedipus striatulus*, with the type locality Cukra, Nicaragua. He mentions a paratypic specimen from Turrialba, Costa Rica.

Dr. Emmet Reid Dunn described *Oedipina alfaroi* in 1921 from Zent, Costa Rica, this being the third species of the long-tailed, long-bodied forms to be recognized. Later Dunn (1924) described *Oedipus colonneus* from La Loma, Bocas del Toro, Panamá, a species which I have found to occur also in eastern Costa Rica. Dunn's important work on the plethodontid salamanders appeared in 1926. In this he reports the known salamander fauna of the country at that date. In this work considerable revisionary work was done, but unfortunately the various genera were lumped together under the preoccupied generic name *Oedipus*, thus often obscuring the true relationships of the species. He lists *Oedipus salvinii* from Marivalles, *Oedipus platydactylus* (based on an earlier record by Günther [1902] of *Spelerpes variegatus* from San Carlos) and *Oedipus lignicolor* from Sarapiquí. Dunn interpreted

certain previous questionable reports as follows: *Spelerpes brocchi* reported by Boulenger (1898) is placed in the synonymy of *Oedipus robustus*; Cope's (1875) record of *Oedipus morio* is referred to *Oedipus subpalmatus* (Boulenger) and *Oedipus variegatus* to *Oedipus liguicolor* (Peters). Dunn synonymizes *Haptoglossa presicauda* Cope with *Oedipus uniformis* Keferstein.

It is highly probable that certain species as treated by this author are to be regarded as composite species, notably *Oedipus uniformis* and *Oedipus subpalmatus*.

Another work that should be mentioned, although in certain cases the identity of species may be questioned, is Albert Günther's *Biologia Centrali-Americana; Reptilia and Batrachia*, published between 1885-1902. The section on the Batrachia dealing with the caecilians and salamanders appeared between December, 1901 and May, 1902. The following species are listed from Costa Rica:

Spelerpes bocourti. From La Palma (1600 meters), and Cariblanco. (This species has been referred to the synonymy of *Magnadigita robusta*.)

Spelerpes subpalmatus. This is composite since certain of the type series is reported by Dunn as being, in the opinion of Boulenger, *Oedipus picadoi*.

Spelerpes morio. This seemingly is based on Cope's (1879) report.

Spelerpes robustus. This is based on Cope's (1894) description.

Spelerpes variegatus. He states "A specimen from this locality [San Carlos, Costa Rica, Underwood, coll.] named *Spelerpes morio*, is in the Natural History Museum." This specimen is believed by Dunn (1926) to be *Oedipus platydactylus*.

Spelerpes uniformis. Costa Rica, La Palma, 1600 m. altitude, Biolly, collector; and Bebedero and Irazú, Underwood, collector (several specimens, probably composite).

Gymnopsis multiplicata. A specimen from Cariblanco, Underwood and Biolly collectors. He places *Siphonops sinus* Cope as a synonym.

Gymnopsis proxima. Based on Cope's (1877) record.

A report by Otto Wettstein, 1934, on a collection made in Costa Rica in 1930 contains records of twelve specimens of salamanders. The species are: *Oedipus subpalmatus*, 10 specimens from Volcan Irazú; *Oedipus picadoi*, La Caja near San José; and *Oedipina uniformis*, "Carrillo am Rio Sucio." The identification of these species was made, at least for the most part, by K. P. Schmidt.

Two papers dealing with the salamander collection made by Richard C. Taylor and me have been published. The first, Taylor (1948) describes *Chiropterotriton abscondens* and *Oedipina syndactyla*, both from the eastern slope of Volcán Poás. The second (1949) makes a hasty review of the known fauna, and describes *Magnadigita nigrescens*, *Bolitoglossa palustris*, *Parvimolge richardi*,

and *Oedipina serpens*. As these species are treated in the present paper, no further comment is made at this time.

The collections made by us and available in the present study total something more than 650 specimens—a number probably larger than has been obtained in past collecting—representing 22 forms, here considered as species.

SALAMANDERS

ORDER CAUDATA Oppel

Caudata Oppel, *Ordnung, Familien und Gattungen der Reptilien*, 1811, p. 72.

SUBORDER PLETHODONTOIDEA

Plethodontoidea Smith and Taylor, *U. S. Nat. Mus. Bull.* 194, 1948, p. 16.

FAMILY PLETHODONTIDAE Gray

Plethodontidae Gray, *Catalogue of the Batrachia Gradientia of the British Museum*, 1850, p. 31 (*part.*).

The salamanders of Costa Rica are representatives of one family and of six genera. That the fauna is an impoverished one is evidenced by the fact that of the four families and the eighteen genera occurring in Mexico, only one family and five genera extend to Costa Rica; and of these, two genera are known to reach Panamá and the mainland of South America. A single genus *Haptoglossa*, with a single species, is known to be endemic in Costa Rica (possibly it will be found to occur also in Panamá since the type locality is in the southwestern part of Costa Rica, not far from the Panamá border). The other genera are represented by several species as follows: *Oedipina* 11; *Magnadigita* 6; *Bolitoglossa* 5; *Chiropterotriton* 2; and *Parvimolge* 1. The distribution of the six genera is as follows:

Bolitoglossa. A genus whose northern range reaches the State of Tamaulipas, Mexico, with representatives of both of the major groups present. It likewise has several representatives of the same two groups in Costa Rica, both of which extend into South America.

Chiropterotriton. A highland genus extending north to Tamaulipas, has two representatives in the mountains of Costa Rica.

Parvimolge. This genus has one species in Veracruz, and another representative in Costa Rica. Collecting in the intervening territory will probably eventually bring to light other species of this group of diminutive salamanders.

Magnadigita. This genus, entering Mexico in Chiapas and Oaxaca, has several representatives in Costa Rica.

Oedipina. A single species of this genus is known to have entered

Mexico, this in the state of Chiapas only. The genus has a number of representatives in Costa Rica and certain ones extending beyond into South America.

Two Mexican genera, *Thorius* and *Pseudoeurycea*, conspicuous in the fauna of the Mexican Plateau, have no known representatives that reach as far southward as Costa Rica. The attached table of known Mexican and Central American genera shows the diminution of the number of genera as one moves southward.

DISTRIBUTIONAL TABLE OF CAECILIAN AND SALAMANDER GENERA FROM MEXICO AND SOUTHWARD

	Western Mexico	Mexican Plateau	Eastern Mexico	Southern Mexico	Chiapanula	Honduras	Salvador	Nicaragua	Costa Rica	Panama	Colombia	Venezuela	Peru	Brazil
Caecilia								×	×	?	×	×	
Dermophis		×	×	×	×	×	×	×	×				
Gymnopsis		×	×	×	×		×	×	×				
Siren		×											
Bathysiredon	×												
Siredon	×												
Rhyacosiredon	×												
Ambystoma	×	×	×											
Taricha	×													
Diemyctylus		×											
Thorius	×	×	×										
Ensatina	×													
Batrachoseps	×													
Aneides	×													
Pseudoeurycea	×	×		×									
Chiropoteritron	×			×	×			×					
Magnadigita			×	×	×		×	×	×	×	×	×	?
Bolitoglossa*		×	×	×	×		×	×	×	×	×	×	?
Parvimolge		×						×					
Lineatriton		×											
Oedipina			×	×			×	×	×	×			
Haptoglossa								×					
Eladia													×

* Occurs also in Ecuador and Bolivia.

KEY TO GENERA OF COSTA RICAN PLETHODONTIDAE

1. Tongue bolitoglossid, free all round, completely protrusible 2
Tongue attached at front and in middle, not completely protrusible *Haptoglossa*
2. Costal folds 17-20, slender elongate *Oedipina*
Costal folds 14 or less, bodies not especially slender or elongate 3
3. Hands and feet completely webbed or palmate with only extreme tip of middle digits free *Bolitoglossa*
Hands and feet not completely webbed or palmate, one or two outer joints of most of the digits free, the tips either broad and truncate or sometimes pointed 4
4. Sublingual fold absent; digits broad, usually truncate . . . *Magnadigita*
Sublingual fold present 5
5. Toes grown together, the tips more or less pointed; diminutive species *Parvimolge*
Toes not grown together; webbing at base distinct; tips of digits rounded, with subterminal pads *Chiropterotriton*

GENUS CHIROPTEROTRITON Taylor

Chiropterotriton Taylor, Univ. Kansas Sci. Bull., vol. 30, 1944, pp. 213-218.

Type of genus: *Oedipus multidentatus* Taylor.

Two species are referred to this genus of small salamanders. Species of this genus are common in Mexico and are known in Guatemala and Honduras, but none are known in the intervening territory, thus leaving a considerable hiatus in the known distribution. Careful collecting in Nicaragua will doubtless disclose the presence of the genus in that country.

KEY TO COSTA RICAN SPECIES OF CHIROPTEROTRITON

- Adpressed limbs separated by 6 costal folds; 13 costal grooves; no palatal perforation; nostril larger *picadoi*
Adpressed limbs separated by 4-4½ costal folds; 14 costal grooves, a large palatal perforation, nostril smaller *abscondens*

Chiropterotriton abscondens Taylor

Text fig. 1

Chiropterotriton abscondens Taylor, Proc. Biol. Soc. Washington, vol. 61, Nov. 12, 1948, pp. 177-178 (type locality, Isla Bonita [American Cinchona Plantation] elev. 5500 ft., Volcán Poás, Costa Rica, R. C. Taylor, coll.).

Diagnosis: A diminutive *Chiropterotriton*, the adpressed limbs separated by 4 to 4½ costal folds; webbing on hands and feet involves only the basal phalanges; nostril small; an arched groove on chin and throat; 14 costal grooves; maxillary teeth 12-16 on each side in males, 19-23 in females; a median palatal perforation between choanae in adults; paravomerine teeth in a single group.

Description of the type: (R.C.T. 1414). One of the smallest species of the genus; the snout-to-end-of-vent length, 32.3 mm., tail, 37 mm. Eye large, one and one-third to one and one-half times length of snout; width of an eyelid minutely less than narrowest interorbital width; nostril small, its diameter in distance between nostrils, about eight times; a transverse groove beginning some distance behind eye crosses the throat to opposite side of head; an arched groove or line on throat and chin, the transverse groove forming its base; behind this is the curved gular fold from whose

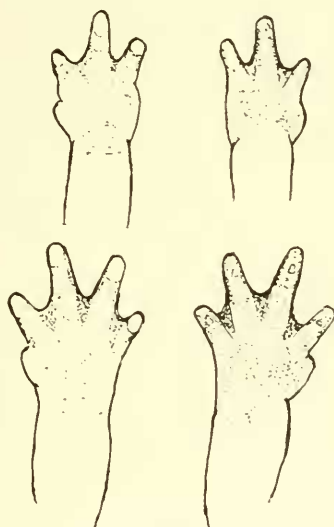


FIG. 1. *Chiropterotriton abscondens*. Type. Upper. Left hand, ventral and dorsal views. Lower. Left foot, ventral and dorsal views. (Much enlarged.)

side a lateral nuchal groove passes up on side of neck, first directed backward then forward and meets its fellow on the median nuchal line; posterior parts of eyelids not tucked under a fold; no orbito-labial groove present; a somewhat sinuous groove from eye to lateral nuchal groove; epibranchial cartilage forms a ridge or fold that extends above arm nearly to third costal groove.

Vomerine teeth 8-8, on elevated ridges beginning outside choanae, curving in and back, the two series separated by a space equal to that between two teeth, or very slightly more; paravomerine teeth forming a single patch, widened and slightly notched behind, separated from the vomerine series by a distance about equal to length

of a one row of vomerine teeth; choanae small; a median open perforation on the palate, the diameter about equal to that of a choanal opening; a free sublingual fold.

Maxillary and premaxillary teeth total 52, of which six apparently are premaxillary; vomerine teeth 8-8; mandibular teeth total 55; tongue bolitoglossoid. Swelling below nostril on edge of lip almost obsolete; 14 costal grooves, and 12 distinct costal folds, the upper edge of the folds somewhat elevated. A median, dorsal groove present; about 28 caudal grooves; cloacal walls with strongly-defined lateral folds; none or only a slight basal caudal constriction; adpressed limbs separated by $4\frac{1}{2}$ to 5 costal folds.

Fingers webbed at base leaving tip of first digit, and one and a half joints of other digits free, the web between deeply excised; toes webbed at base, the tip of first digit and two joints of other digits free of web. Distinct pads under tips of digits.

Skin generally smooth, but under a lens the opening of glands give a somewhat pitted appearance; a postiliac glandular spot scarcely discernible.

Color: Above brown, with a lighter cream spot on snout in front of eyes; a pair of indefinite lighter areas on nuchal region; an indistinct row of darker flecks along the dorsolateral line, bordered above posteriorly by a lighter streak; tail brownish fawn, lighter at base, growing darker low on sides, and flecked with black; underside of body and tail and to some extent low on sides of body, uniform brown; under lens small whitish flecks present on sides of neck and below eye.

Measurements in mm.: Snout to end of vent, 32.3; tail, 37; width of head, 4.5; length of head from tip of snout to mid-ventral part of gular fold, 5.5; width of head in snout-to-vent length, 7.2; length of head in snout-to-vent length approximately 5 times; arm, 5; leg, 5.3; snout to arm insertion, 8; axilla to groin, 19.

Remarks: The curious opening in the palate, according to Mr. Irvin Baird who dissected the area, serves as the opening for a gland situated on the top of the snout and in the fontanelle opening between the processes of the premaxillary. The opening occurs in certain other species of salamanders.

The males have a somewhat larger swelling below the nostril and the cloacal opening is papillate. More details of variation in the species is given with the type description. The species is known only from the type locality in northern Costa Rica.

Chiropterotriton picadoi (Stejneger)

Spelerpes picadoi Stejneger, Proc. U. S. Nat. Mus., vol. 41, Aug. 14, 1911, pp. 285-286 (type locality, La Estrella, southeast of Cartago, Costa Rica, C. Picado, coll.); Picado, Les Broméliacées Epiphytes, 1913, p. 342, pl. 8, fig. 4.
Chiropterotriton picadoi Taylor, Univ. Kansas Sci. Bull., vol. 33, pt. 1, 1949, pp. 279, 280, 281.

Diagnosis: Legs short, failing to meet on sides by 6 mm. (length of hind leg); fingers and toes well developed, slightly webbed; vomerine teeth well separated from paravomerine tooth patch, not extending beyond choanae; 13 costal grooves; body elongate, tail cylindrical; color brown.

Description: (taken from Stejneger): Vomerine teeth in two arched, continuous series, not extending outward beyond choanae, and well separated from the paravomerine teeth, which form a single patch; head wider than body, truncate; snout short; corner of mouth under posterior edge of eye; nostrils large, rounded; body elongate, measuring four times distance from snout to gular fold, and more than three times in distance between axilla and groin; legs short, not meeting on sides by length of hind leg; fingers and toes well developed, slightly webbed; tail cylindrical, longer than head and body; skin very smooth, a distinct gular fold; 13 costal grooves. Color (in alcohol) above dark brown, with a pale irregular band extending from behind eye backward over shoulder along sides to groin, and another similar one, but fainter, from occiput on each side of back disappearing on anterior third of tail; underside paler; palms and soles still more so.

Measurements in mm.: Total length 66; snout to vent 31; tail 35; snout to gular fold 6; width of head 4; axilla to groin 20; arm 5; leg 6.

Remarks: I have examined the type specimen. The following additional characters obtain: eyelid equally as wide as interorbital distance, the eye being one and one-half times as long as snout; diameter of nostril (.3 mm.) contained in distance between nostrils (1.2 mm.) approximately four times; a distinct groove from eye to the groove crossing chin, and a groove from this to the lateral nuchal groove; tail not constricted at base; an arched groove on chin; a strong sublingual fold. Approximately 18 maxillary teeth, and at least 6 vomerine teeth in each series, the latter separated from the paravomerine teeth by a distance equal to length of one vomerine series.

The relationship of this species is, I believe, undoubtedly with the species I have described as *Chiropterotriton abscondens*. These

forms agree in having a sublingual fold and the arched groove on the chin, the large eye, approximately the same degree of development in the hand, *picadoi*, however, having the first finger somewhat more free. They likewise agree in general body characters and appearance.

The differences that appear most significant are the wide perforation of the palate in *abscondens*, the very small nostrils, probably less than one fourth of the pupil (enlarged in the very young), and the somewhat longer limbs (separated by four, very rarely nearly five costal grooves). Dunn has reported *picadoi* from La Palna, Costa Rica, and notes that the nostril is half as large as the pupil in certain specimens, and in one, a male, even a larger nostril (snout-to-vent length 25.5 mm. and not a juvenile). All juveniles presumably have large nostrils in these species. It may be that this juvenile condition is retained in *picadoi*, and lost in *abscondens*. It is also significant that the palate perforation is evident in a Harvard specimen (No. 5125) identified as *picadoi*.

The head width in snout-to-vent length in *picadoi* is 7.75 times, head length (to gular fold) in same, 5.16 times; in *abscondens* the proportions are 7.1 and 5.8, respectively.

Genus MAGNADIGITA Taylor

Magnadigita Taylor, Univ. Kansas Sci. Bull., vol. 30, 1944, p. 218.

Type of genus: *Bolitoglossa nigroflavescens* Taylor.

Of this genus, which ranges from central Veraacruz to and into South America, six forms are known to occur in Costa Rica. Three of these, *pesrubra*, *torresi* and *cerroensis*, are here described as new.

The relationship between *torresi* and *pesrubra*, two forms that occur at very high elevation on Cerro de la Muerte, is puzzling. *Pesrubra* extends to considerably lower elevations than *torresi*.

KEY TO COSTA RICAN SPECIES OF MAGNADIGITA

1. Very large plump forms reaching 110 mm. snout-vent length; nearly uniform black or slate black, save for a cream ring about base of tail. *robusta*
- Medium-sized forms (less than 70 mm. snout to vent) lacking a light ring about tail. 2
2. Maxillary teeth much reduced 7-9 (total 16); color nearly uniform blackish above, somewhat lighter slaty black on sides and ventral surfaces *nigrescens*
- Maxillary teeth not greatly reduced; colors variable. 3
3. Maxillary teeth total 62-78 in adults; mandibular teeth 73-97; caudal grooves 40-46. Dark colored, blackish brown to gray

- brown, lighter below, often with small flecks or spots of red, rarely with an irregular stripe of buff on dorsum; costal grooves distinct *subpalmata*
- Maxillary teeth in adults fewer than 60; caudal grooves usually less than 30; costal grooves variable in distinctness 4
4. Legs never light or red colored, usually nearly body color; maxillary teeth 45; mandibular teeth 70; costal grooves indistinct; caudal grooves 25; brown above, not uniform; venter lavender with numerous cream flecks; throat not lighter than venter *cerroensis*
- Legs usually red, yellowish or cream, rarely or never colored like body; chin and throat always lighter than venter 5
5. Larger species (67 mm. snout to vent); maxillary teeth total 50 to 57; mandibular teeth total 58 to 74; caudal grooves 25 to 31; legs bright red or pink; chin and throat reddish; dark dorsally with variable venter *pesrubra*
- Smaller species (54 mm. snout to vent); maxillary teeth 45; mandibular teeth 48. Dorsum gray olive, brown or blackish, uniform or with occasional light areas. Venter black, the color encroaching on sides; chin and breast unpigmented, usually cream or pinkish; costal grooves usually blackish *torresi*

Magnadigita pesrubra sp. nov.

Plate LXXVI; text fig. 2

Type: Kausas University Museum of Natural History No. 25093 ♀; Cerro de la Muerte, Costa Rica, elev. 10,900 ft.; E. H. Taylor and R. C. Taylor colls.

Paratypes: K.U.M.N.H. Nos. 25082-25092; 25094-26100, Cerro de la Muerte (where Pan-American Highway crosses) elev. 10,900 ft.; Nos. 25142-25156, Millville, western exposure of Cerro de la Muerte, 9416 ft. elev.; No. 25157 (lot of 166 specimens, from 9416 to 10,900 ft. elevation, Cerro de la Muerte; R.C.T. Nos. 3583 [lot number for 128 specimens]). 9416-10,900 ft., Cerro de la Muerte.

Diagnosis: A moderately large form reaching a snout-to-vent length of 67 mm.; tail 64 mm.; tongue bolitoglossid; no sublingual fold; paravomerine teeth in a single patch; 13 costal grooves (counting one in axilla); limbs when adpressed separated by two and one-half costal folds; tail somewhat constricted at base; 28 + caudal grooves; digits with webs, the web including inner finger and toe; the other digits having from one and one-half to two phalanges free; limbs pink or red; a pinkish area on side of neck and head involving also chin and part of breast; dorsum and sides blackish or blackish brown; ventral surface slate black or brownish black.

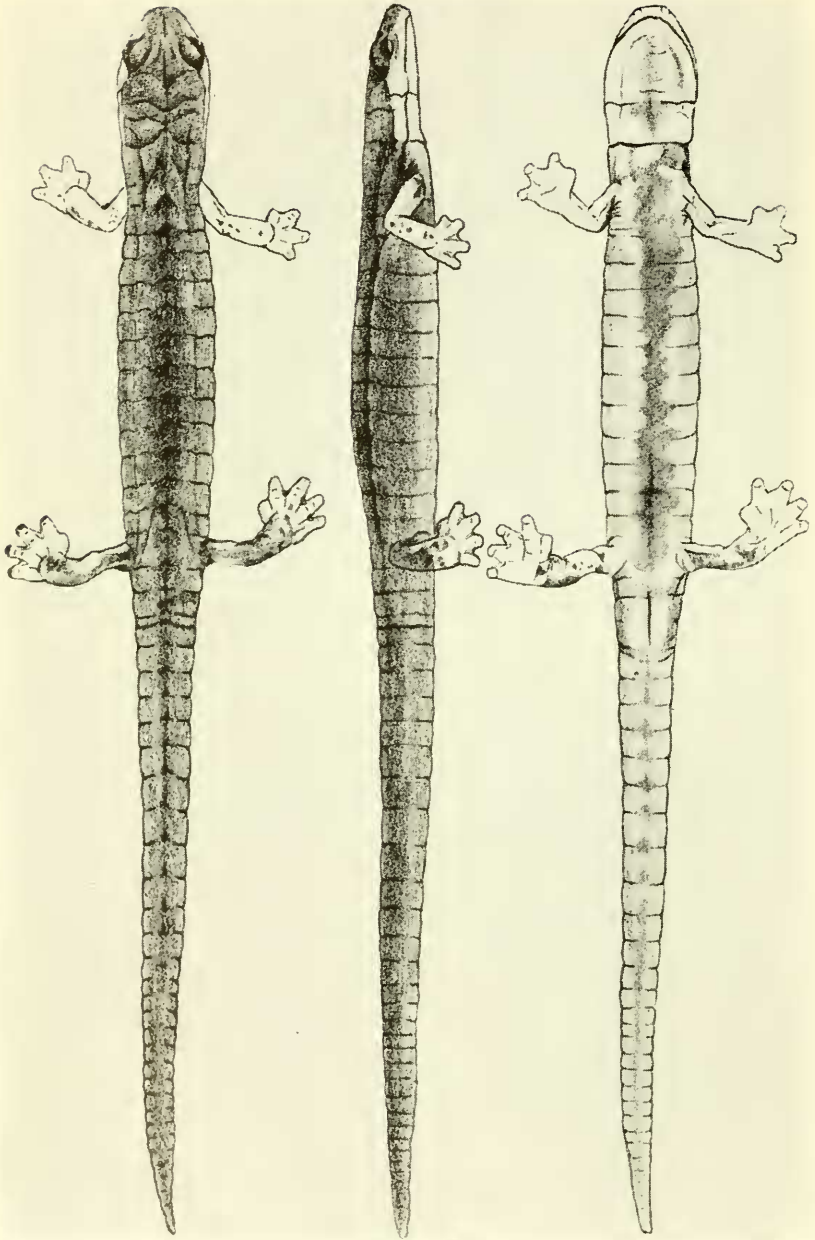


PLATE LXXVI. *Magnadigita pesrubra* sp. nov. Type, K.U.M.N.H. No. 25093. Total length, 128 mm.

Description of type: Head rather flattened, the eyes relatively small, their length distinctly less than length of the snout; no canthus; nostril nearly terminal; a small subnarial swelling below nostril (larger in males); more or less distinct groove borders inner edge of orbit; width of an eyelid (1.8) in interorbital interval (4 mm.) a little more than two times; a groove from side of head crosses in front of jaw angle, and passes across the chin; a distinct gular fold passing straight across the neck and reaching up somewhat on side of neck; from this emerges the lateral nuchal groove which passes vertically some distance then runs diagonally forward to meet its

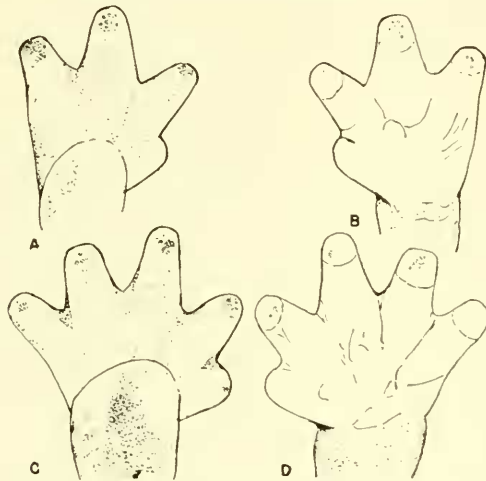


FIG. 2. *Magnadigita pesrubra*. Type. A. Left hand, dorsal view; B. Left hand, ventral view; C. Left foot, dorsal view; D. Left foot, ventral view. (Much enlarged.)

fellow on middorsal line; (males with a small submental hedonic gland); posterior ends of eyelids tucked under a short diagonal fold; a deep groove from eye curves down to touch the beginning of the groove that crosses chin then runs back to touch the beginning of the lateral nuchal groove, the whole line forming an angle.

Choanae small, with a narrow emergent groove; vomerine teeth on two elongate curving ridges beginning beyond outer level of choanae, curving back slightly but failing to meet on the median line by a distance equal to greatest diameter of a choana; about 12 teeth on each side; paravomerine teeth in single large patch 6 mm. long, its greatest width 4.5 mm. posteriorly, the least width anteriorly

1.8 mm.; the number of mandibular teeth 28-28; premaxillary teeth 3.

Adpressed limbs separated by two and one-half folds; webbing on hand leaves only inner tip of first finger free; other toes with two phalanges free (or slightly more) the web however forming a fringe so that free part of toes are wider at base than tip; inner toe with only tip free; other toes with one and one-half to two phalanges free, the web slightly excised. Body subcylindrical, the tail slightly compressed, higher than wide; thirteen costal folds (counting one in axilla), and well defined on venter to mid-ventral line; a distinguishable longitudinal depression above the costal folds; surface of the latter longitudinally wrinkled. Tail constricted at base; about 28 caudal grooves, and a small portion of the tail (12 mm.) in which the grooves cannot be discerned; tail approximately as long as head and body.

Color in life: Above dark lead to brownish black; arms pink to red; hind feet somewhat orange-pink with some pigmentation on the thigh and tibia; a faint lighter spot on glandular area behind insertion of hind limb; chin and throat to gular fold, immaculate pink, the color becoming somewhat more reddish on side of neck below the postorbital groove and on the side of the head; venter dull gray or brownish slate, lighter than on dorsum, with an occasional pinkish fleck; tail slate, scarcely lighter on its ventral surface.

Measurements in mm.: Snout to end of vent, 67.2; snout to foreleg, 17.3; axilla to groin, 37; tail, 66; width of head, 9.5; length of head to gular fold, 16; width of body, 10.4; arm, 15.2; leg, 15.2; head width in snout-to-vent length, 7.05 times; head to gular fold in same, 4 times.

Variation: The pink or red coloration of chin, throat, arms and legs is, I think, invariably present; however there may be some darker pigmentation present on the limbs. Rarely there may be very little pigment also on digits but these are more frequently without any pigment. Occasional specimens may have the venter somewhat brownish, in which case the brown may be more or less evident on sides of dorsum. Occasional specimens have the pink color replaced in part with orange, especially on the side of the head.

Remarks: In the forested areas where *pesrubra* was taken, specimens were encountered about logs and in piles of trash and leaves. Many of the females have large yellow ovarian eggs, and a few egg masses were found in leaves with the female coiled about them.

MEASUREMENTS AND DATA ON MAGNADICITA DESRUBRA

No. (field)....	3583	3577	3589	3536	3575	3578	3553	3534	3540	3558
Sex.....	♀	♀	♀	♀	♀	♂	♂	♂	♀	♂
Snout to vent.....	67	66	62	62	60	57	56	55	54	54
Snout to foreleg.....	17	16.5	17.6	17.3	16	17	17	16	15.5	16
Axilla to groin.....	37	36	35	33	34	29.5	29.2	29	29.6	28
Tail.....	63	65	36 +	62	60	59	59	57	52	57
Arm.....	14	14	13	12	14	13	13	13	11	13
Leg.....	15	15	14	14	14	14	14	13	12	13
Head width.....	9.2	9.2	8.7	9	8.8	8	9	9	8.9	9
Head length (gular fold).....	13.5	14	13.7	14	12.3	13	13	13	12.1	12.7
Head width in snout to vent length.....	7.28	7.14	7.15	6.9	6.87	6.46	6.22	6.11	6.18	6.0
Head to gular fold in same.....	4.96	4.70	4.54	4.43	4.91	4.39	4.30	4.23	4.20	4.25
Costal grooves.....	13	13	13	13	13	13	13	13	13	13
Caudal grooves.....	28 +	31 +	25 +	26 +	30 +	29 +	30 +	31 +	31 +	30 +
Maxillary teeth (total).....	57	54	55	50	54	55	52	54	54	54
Premaxillary teeth.....	4 +	4	4	4	5	3	3	5	5	5
Premaxillary teeth.....	33	27	25	21	29	25	23	26	31	29
Paravomerine teeth.....	174	170	106	131	120	138	144	148	140	120
Mandibular teeth.....	74	72	67	59	67	68	74	74	58	67

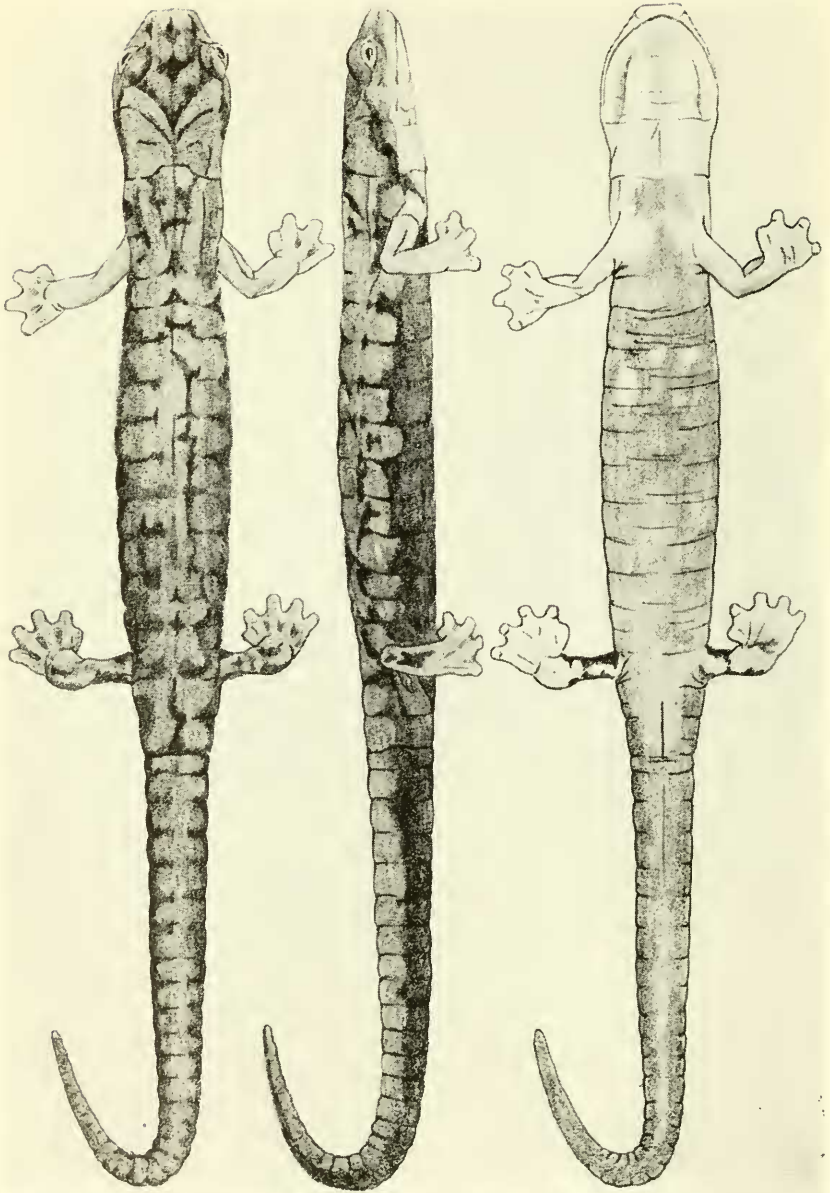


PLATE LXXVII. *Maguadigita torresi* sp. nov. Type, K.U.M.N.II. 25104.
Total length, 111 mm.

Magnadigita torresi sp. nov.

Plate LXXVII

Type: Kansas University Museum of Natural History No. 25104 ♂, Summit of Cerro de la Muerte, Costa Rica (where Pan-American Highway crosses) 10,900 ft. elev., Aug. 17, 1947; R. C. Taylor and E. H. Taylor collectors.

Paratypes: K.U.M.N.H. Nos. 25101-25103; 25105-25116; 25116A (lot number for 30 specimens); R.C.T. No. 3485 (lot number for 42 paratypes). All topotypes.

Diagnosis: A medium-sized salamander reaching a known snout-to-vent length of 54 mm.; tail 55 mm.; the width of head in snout-to-vent length 5.8 times; adpressed limbs separated by two costal folds; tongue bolitoglossid; no sublingual fold; paravomerine teeth in a single patch; tail constricted at base; 13 costal, 29 + caudal grooves; usually brown more or less flecked or clouded with black; venter slate-black or black with lighter spots; chin and breast not pigmented; the side of head and neck usually more or less pigmented, but less so than top of head; usually an irregular dark mark from eye to arm; digits truncate at tips.

Description of type: A medium-sized species, the head not broader than the body, its width in snout-vent length 5.8 times; eye of moderate size, the width of an eyelid (2 mm.) much narrower than the narrowest interorbital distance (2.8 mm.); top of head flat, but curving slightly forward; snout moderately high, sharply truncate; subnarial swellings prominent; a groove begins behind eye, runs somewhat diagonally back to where it bisects a groove that crosses jaw angle and chin, but does not reach back to the nuchal groove; a strong gular fold passing nearly straight across neck; at its terminus the nuchal groove arises, passes slightly forward and upward to dorsal level of body and can be traced to the median line; the posterior corners of eyelids end at a short groove, but there is no diagonal fold present; maxillary teeth 22-23; the premaxillary teeth five, piercing the gum; vomerine teeth in two short rows of 12 teeth each, the rows beginning beyond outer level of choanae, curve in and strongly back, but are separated mesially by a distance a little less than width of a choanae and from the paravomerine teeth by an equal distance; paravomerine teeth in a single group bearing approximately 132 teeth; mandibular teeth approximately 24-24; no sublingual fold; 13 costal grooves counting one in groin, the last two costal folds only partially separated, the groove not descending to lower level of body; 29 caudal grooves,

usually distinct across ventral surfaces and reaching high on sides; cross section of the body subtriangular rather than subcylindrical; the tail is subcylindrical. Skin showing rather indistinct pitting, the sides with fine corrugation; a postiliac glandular spot.

Arm moderately long, fingers webbed, the first largely involved in web with only a rounded tip free; other toes with two phalanges free, their sides subparallel; inner toe almost completely involved in web, the three middle with approximately two free phalanges, the outer with little more than one phalanx free; all of the digits save two inner with a small subterminal pad; cloacal walls papillate (female with diagonal folds).

Color: Above, dull olive-brown clouded and flecked with blackish, and many of the costal grooves blackish; venter slate-black with a few small light flecks, the dark color reaching up a short distance on the sides. Chin, cream or pinkish; sides of head and snout lighter than top of head, but usually pigmented except on upper lip; an indistinct dark line from eye to arm, below which the color is much lighter; arm light brown lightly pigmented save on under surface which may have areas without pigment; breast lighter, somewhat clouded with darker (the clouding more frequently absent). Tail brownish above, clouded and flecked with black, the sides and ventral parts slate-black.

Measurements in mm.: Snout to end of vent 55; tail 56; snout to foreleg 16; axilla to groin 30, width of head 8; snout to gular fold 12.8; arm 10.8; leg 13.

Variation: This species and *pesrubra* occupy the same identical habitats on the summit of Cerro de la Muerte, occasionally both forms being taken under the same rock or mass of moss. Adults of the two forms may usually be readily differentiated; however, the young of the two species are somewhat difficult to separate. The reason for this is the very considerable variation in color and markings of both species. The most common dorsal markings of *torresi* are a brown dorsum, the sides brownish to an irregular line a little below midway, then the remainder of side black, with a blackish venter. Occasionally the brown of the body extends on to the tail a greater or lesser distance. Only rarely however is the brown uniform; it may be flecked or clouded with dusky; the head may be darker than body, blackish, with flecks of brown, or brownish flecked with black. The limbs are lighter than dorsal color and may sometimes be pinkish. The sides of neck and of head are usually pigmented like the top of the head, or they may be

lighter. The chin and breast, however, are light flesh, occasionally with a pinkish reflection or wash. The abdominal region is often spotted with from two to five large lighter spots, irregularly disposed.

There are two characters that differentiate this species: the smaller size, and the characteristic of the hands and feet. Thus the emarginations between the digits are V-shaped in *pesrubra* and more nearly U-shaped in *torresi*. This is due to the fact that the webbing between the fingers and toes of *pesrubra* tends to form a fringe of diminishing width and extends farther out than the depth of the emargination. The shape of the free parts of the digits are thus somewhat triangular, their tips more rounding, less truncate. In *torresi* the toes are somewhat more truncate and the web extends but little beyond the level of the emargination between the digits. Thus the free part of the digits themselves have their sides more nearly parallel and are more nearly quadrangular than triangular.

Remarks: This species was found to be especially common under rocks, in moss about bamboo clumps, in fact almost anywhere that cover could be found. There is no forest, but there are extensive thickets, of a dwarf bamboo that reaches a height of *circa* ten feet. There are other shrubs, a few boulders and scattered rock. The place is subject to sudden changes of temperature and ice is said to be not uncommon. On one day (Aug. 17) we were collecting there when the temperature dropped rather suddenly to near 40 degrees F. With wind and rain falling through a heavy fog, we were soaked and prevented from finding familiar territory for several very miserable hours. Numerous travelers coming up from the hot coastal lowland to cross over the mountain-pass to the opposite side are said to have lost their lives here on this summit because of the cold. Thus the name, Cerro de la Muerte, the mountain of death.

Magnadigita subpalmata (Boulenger)

Plates LXXVIII. LXXIX

- Spelerpes subpalmatus* Boulenger, Ann. Mag. Nat. Hist., ser. 6, vol. 18, 1896, pp. 341-342 (type locality, La Palma, Costa Rica; collected by C. F. Underwood); Proc. Zool. Soc. London, June 7, 1898, p. 478; Günther, Biologia Centrali-Americana; Reptilia and Batrachia, Dec. 1901, pp. 300-301.
- Oedipus subpalmatus* Dunn, Field Mus. Nat. Hist., Zool. Ser., 1924, vol. 12, pp. 99, 100; The Plethodontidae, Smith College Publ., 1926, Northampton, Mass., pp. 390-393 (Costa Rican localities given are Rancho Redondo, Turrialba, Barba and Irazú [volcanoes], Cot, Poás [volcano], Tablaze [?], Cerro de la Muerte).
- ? *Oedipus norio* Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 96; Proc. Amer. Philos. Soc., vol. 18, p. 271.

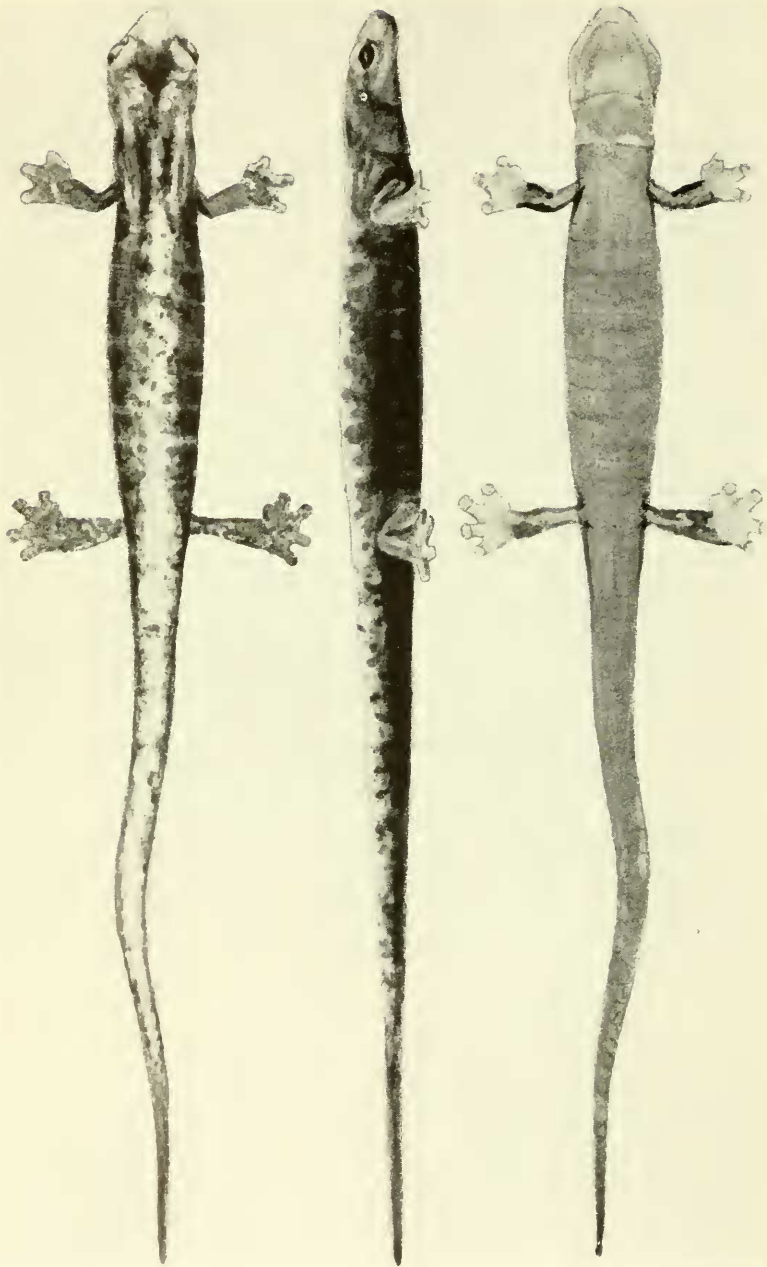


PLATE LXXVIII. *Magnadigita subpalmata* Boulenger. Color variant. R.C.T. No. 3131, Isla Bonita, eastern drainage, Volcán Poás, Costa Rica. Total length, 127 mm.

Magnadigita subpalmata Taylor, Univ. Kansas Sci. Bull., vol. 30, pt. 1, May 15, 1944, p. 218 (referred to *Magnadigita*); *idem*, vol. 33, pt. 1, April 20, 1949, pp. 279, 280, 281 (occurrence in Costa Rica).

Diagnosis: Medium-sized species, reaching 60 mm. in snout-to-vent length; maxillary teeth in adults total 62 to 78; mandibular teeth 73 to 97; dorsum dark lavender brown, blackish brown or grayish black, rarely speckled with red or with a buff line; venter uniform blackish or blackish brown, lighter than the dorsum; caudal grooves 40-45.

Description of species: (K.U.M.N.H. No. 28124 ♂). Head but little broader than body (except gravid females with body distinctly wider); width of upper eyelid (2.8 mm.), in interorbital distance (3.6 mm.) about 1.3 times; snout truncate, curving very slightly when seen from above; prominent swellings below nostril; a large hedonic gland on chin; eye longer than snout; a strong groove from behind eye runs back and down, continuous with a groove that crosses back of jaw and surface of throat; a gular fold, passing nearly straight across neck; nuchal grooves arising on each side of fold continuous to middorsal line; a secondary vertical groove more or less evident between the nuchal groove and that crossing back part of jaw; occiput, interorbital and preorbital areas with small pits, the skin thickened with small depressions tending to form a reticulum; a slightly depressed groove follows outline of upper eyelid; nostril small; palate in front of prevomers vaulted, with a minute medial opening; choanae small, the diameter of one (.25 mm.), contained in the distance between the two (2.2 mm.) six times; maxillary teeth 38-37; vomerine teeth, 12-12, on two elevated ridges becoming lower mesially; paravomerine teeth about 170 in single patch with a slight toothless line mesially; mandibular teeth about 42-42. Arm short, its length in snout-vent length 4.2 times; leg in same distance, 3.9 times; fingers broad truncate, the outer webbed at base, the first almost wholly involved; the three outer free for two to two and one-half phalanges; four outer toes likewise free for about same distance; adpressed limbs separated by one and one-half to two costal folds; 13 costal grooves and 12 costal folds, the posterior groove somewhat in front of limb insertion; tail longer than head and body, cylindrical, constricted a little at base; 44 caudal grooves; a distinct longitudinal, lateral groove above thickened part of costal folds; a postiliac gland (behind insertion of leg).

Color: General color slate-gray with brownish flecking evident over back; sides slightly lighter in tone than back; chin dirty gray-

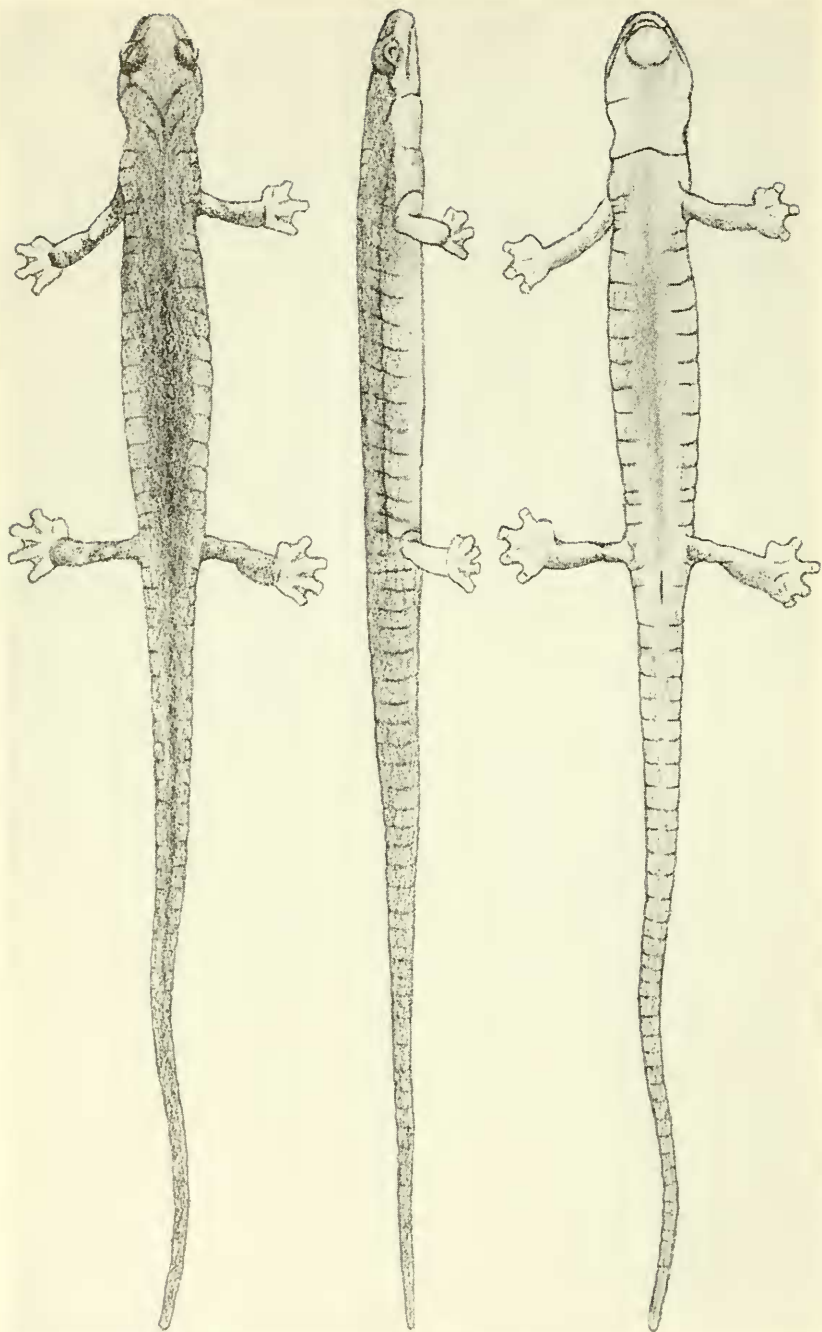


PLATE LXXIX. *Maguadigita subpalmata* Boulenger. Typical. K.U.M.N.H. No. 28124, Isla Bonita, eastern drainage Volcán Poás, Costa Rica. Actual size.

cream as are under surfaces of hands and feet, and to a lesser extent, arms and legs; venter grayish. the median area darker than outer portions; tail dark above flecked with brown; below almost uniformly dark; a few lighter flecks near base of tail and on under surface of legs.

Variation: The color of *Magnadigita subpalmata* varies considerably. Boulenger calls attention to it in the type description.

In the large series at hand there are two general types of coloration.

1. Gray black on dorsal and lateral surfaces of head, body and tail; or blackish with indistinct clouding or indefinite flecks of brown, or reddish brown. In these specimens the ventral surface is often uniform brownish black, or leaden with a few scattered cream flecks. Occasionally in this form the brown is united to form fawn or reddish cream spots, or rarely a broad median stripe with irregular edges that may extend to the tip of the tail.
2. Uniformly grayish black above with lighter venter of a dirty grayish flesh-color, that extends up to near the middle of the sides. In these specimens the costal folds appear as darker lines on the lighter coloring. These specimens when placed under water show a very slight brownish mottling but seemingly none of them have the whitish ventral flecks.

Females generally have a broader head and body than males of the same snout-vent length. The number of caudal vertebrae is normally between 40-45 in all adults, the tip being less differentiated in some of the specimens than in others. The tooth-count shows an increase in teeth for increase in body length. The maxillary tooth-count for the largest specimens (57.5 to 58.6 mm. snout-vent length) is between 37 and 40 on each side; premaxillary teeth in females are six or eight; in males they pierce the lip and are usually five in number. They are sometimes lost and sometimes the missing tooth may be found deep in the lip tissue. The prevomerine teeth in this size group vary between 13 and 17, the teeth beginning considerably outside the outer level of the choanae. The expected number of paravomerine teeth for this group seems to vary considerably, the average being about 170. The mandibular teeth on each side number between 42 and 50. The number of teeth present reduces rapidly as younger, smaller specimens are counted.

The length of the free part of the fingers was greatest in a specimen taken in a bromelia at Cervantes, and some slight differences in the size of the hand and foot were noted in the other populations.

TABLE OF DATA AND MEASUREMENTS OF *MAGNADIGITA SUBPALMATA*

COLLECTION	RCT		KUMNH		KUMNH		KUMNH		KUMNH		KUMNH		RCT	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Number.....	3131	2104	3136	28108	28119	28124	28107	28126	3134					
Sex.....	♂	♀	♂	♀	♀	♂	♂	♂	♂					
Snout to vent.....	58	58	58	57	51	55	55	53	53					
Snout to foreleg.....	18	15	18	15	15	15	15	14	14					
Axilla to groin.....	31	34	31	32	28	30	30	29	30					
Tail.....	71	75	61	lost	56	75	72	72	72					
Arm.....	12	11	11	11	11	13	12	12	12					
Leg.....	12	13	12	12	12	14	12	13	12					
Head width.....	8	8	9	9	9	8	8	7	7					
Head length.....	14	12	13	13	12	12	12	11	12					
Head width in body length.....	6	6	6	6	5	6	6	6	7					
Head length in body length.....	3	4	4	4	4	4	4	4	4					
Costal gill axes.....	12	13	13	13	13	13	13	13	13					
Maxillary teeth.....	37-38	40-38	36-39	33-36	28-29	38-37	29-33	30-32	35-35					
Premaxillary teeth.....	6	6	7	8	5	4	5	5	3					
Preopercular teeth.....	13-15	17-17	16-14	14-15	12-14	12-12	11-12	15-15	12-14					
Parasphenic teeth.....	174	194	155	168	152	171	148	182	176					
Mandibular teeth.....	49-48	48-44	45-50	42-42	42-42	42-42	36-38	35-38	43-44					

Specimens from high on Volcán Irazú are seemingly somewhat dwarfed.

Remarks: Specimens were taken at the following localities: Volcán Irazú, 8500 ft. elevation (six specimens in bromelias); Volcán Irazú "Roberts Hotel 7000 ft.," one specimen collected by Prof. Rubén Torres Rojas; Cervantes, south slope of Volcán Irazú, 5000 ft. elevation in bromelia; Isla Bonita (American Cinchona Plantation); Volcán Poás, 5600 to 6500 ft., 43 specimens. This latter group of specimens were found on the ground at night moving over the surfaces where road-cuts left more or less vertical surfaces with a meagre growth of small plants or mosses. Specimens were taken here only at night. The land had recently been cleared of forest and no bromelias were available at the immediate places where the specimens were taken. No examples were found in the daytime, nor were their daytime hiding places determined.

The tail has a slight constriction at its base but the tails are not especially fragile, since only two or three of this large series have lost their tails. This, in part, may be a result of their quietness when picked up.

The Cervantes specimen has distinctly longer and slenderer fingers.

Magnadigita nigrescens Taylor

Plate LXXIXA; text fig. 3

Magnadigita nigrescens Taylor, Univ. Kansas Sci. Bull., vol. 33, part 1, Apr. 20, 1949, pp. 282-283 (type locality, Boquete Road Camp, on Pan-American Highway, between Millville and San Isidro El General, Costa Rica; elevation 6000 ft., E. H. Taylor coll.).

Diagnosis: Uniformly blackish above, slaty black on sides and ventral surfaces; hand and foot webbed, the terminal joint of truncate digits free of web except that of inner digits; thirteen costal grooves; nostril small; paravomerine teeth in a single patch, notched behind; 11-11 vomerine teeth, each series arranged partly in two series, beginning outside level of choanae, the two groups separated by twice the diameter of a choana; no sublingual fold; maxillary teeth reduced, 7-9.

Description of the type: (K.U.M.N.H. No. 23816; field No. 914.) Adult ♀; head broad, the snout bluntly rounded, somewhat truncate; a slight swelling on lip below nostril; eye moderate, its diameter longer than snout; posterior part of eyelids fit under a diagonal fold; a strong gular fold on neck with a nuchal groove arising from each side, which meets its fellow on the middorsal line of the neck; anterior to gular fold, a groove completely crosses

chin and ascends either side of head, crossing near angle of mouth and terminating at the postorbital groove; latter arises at eye, and extends back but does not reach nuchal groove; thirteen costal grooves counting those in axilla and groin; adpressed limbs sepa-

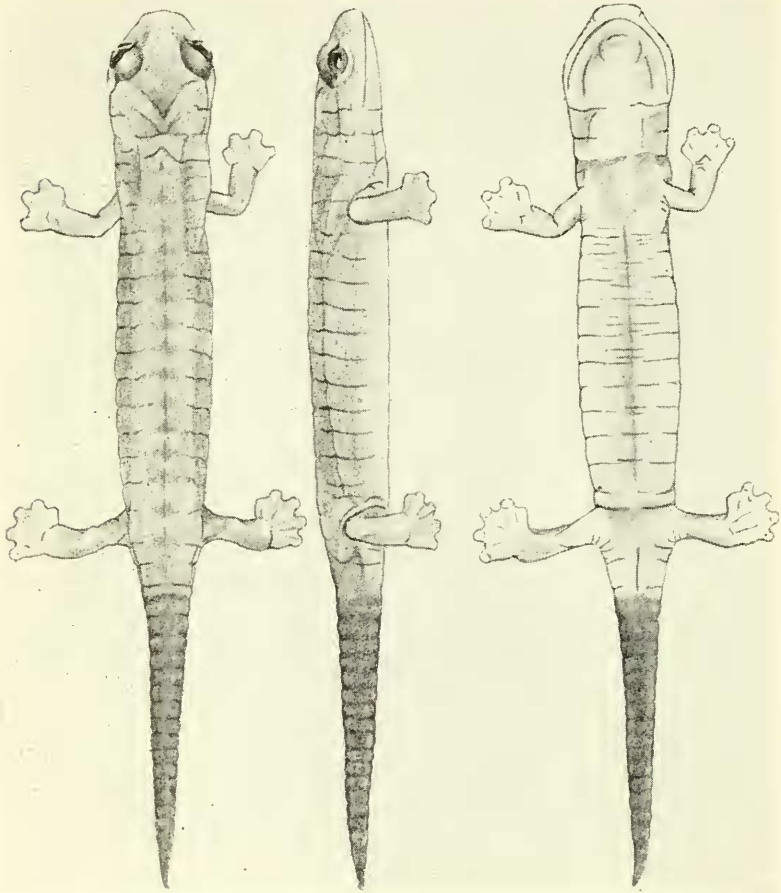


PLATE LXXIXA. *Magnadigita nigrescens* Taylor. Type K.U.M.N.H. No. 23816, Boquete Camp between Millville and San Isidro El General, elev. 6000 ft., Costa Rica. Total length, 70 mm.

rated by between two and one-half to three costal folds; fold resulting from the posterior extension of the epibranchial cartilage reaches second costal fold; tail regenerating; presumably a basal constriction on tail; walls of cloaca with smooth folds; glandular area behind insertion of leg not especially distinct.

Skin generally smooth, but area on snout and interorbital region somewhat rough; venter crossed by very numerous fine striations.

Limbs rather short, the broad digits united by a web, almost palmate; the terminal joint of the digits, other than the inner, subtruncate, with terminal joint free, and small subterminal pads present below tips of digits; between toes the web may be slightly excised.

Floor of mouth without a sublingual fold; choanae very small, their diameter contained in distance between them about six times;

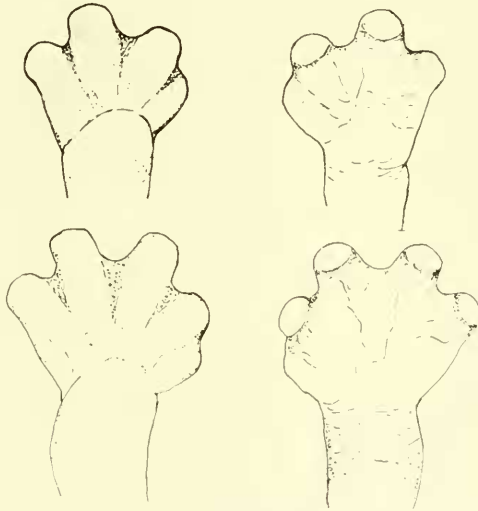


FIG. 3. *Magnadigita nigrescens*. Type. Upper. Left hand, dorsal and ventral views. Lower. Left foot, dorsal and ventral views. (Much enlarged.)

paravomerine teeth in a single elongate patch widening gradually posteriorly and notched behind, anteriorly narrow and, save for two or three scattered teeth, widely separated from the vomerine teeth; the vomerine series of about eleven teeth each begin beyond the outer level of the choanae and curve back, separated from each other by a distance equal to twice diameter of choana; each series arranged partially in two rows; maxillary teeth small, 7-9 almost covered by gums; only a single premaxillary tooth present; 25 mandibular teeth on each side of jaw.

The tail (regenerated) is shorter than head and body, with eighteen caudal grooves discernible; width of head in head-body length, 5.2 times; length of head to gular fold (lateral) in head-body length, 3.9 times.

Color: In life nearly uniform slate-black above and below; in preserved state the dorsal color is dark brown, the sides slate-black, the venter blackish brown; under side of limbs lighter brown; under side of hands and feet grayish white; chin lighter brown than venter.

Measurements in mm.: Total length (tail regenerated), 70; snout to arm, 15; snout to end of vent, 46; axilla to groin, 25; arm, 9.8; leg, 10.1; head width, 8.8; head length to gular fold (lateral), 11.8; head length to gular fold (median), 11.1.

Remarks: Only a single specimen of this species was taken. It was obtained from within the naturally-hollow stalk of a large-leaved plant. The entrance had been gained through a hole bored by an insect. It was found nearly a meter below the point of entrance when the stalk was accidentally split.

The great reduction of the maxillary teeth occurs in no other Costa Rican species of the genus that I have examined, and I am uncertain as to its closest relationship.

Magnadigita cerroensis sp. nov.

Plate LXXX

Type: University of Kansas Museum of Natural History No. 29961, collected on Cerro de la Muerte at approximately 7000 feet elevation, Pacific slope, 2 km. below Millville on the Pan-American Highway, August 15, 1947; R. C. Taylor and E. H. Taylor collectors.

Diagnosis: Light brown on body and limbs; venter, chin and part of underside of tail lavender-brown with numerous cream flecks. Tail darker, approaching blackish at the dorsal tip; shorter than snout-vent length; snout high, rather narrowed but truncate; 13 costal grooves, scarcely discernible; adpressed limbs separated by two costal folds; maxillary tooth series reduced, 22-23; mandibular teeth 34-36; paravomerine teeth 141; tongue free without trace of a sublingual fold.

Description of type: A medium-large species of the genus; head distinctly wider than the body; the snout short, constricted or narrowed in front of eyes, relatively thick; length of eye (length of eyelid) slightly less than length of snout; width of upper eyelid in interorbital distance, 1.8 times; tip of snout rather truncate (actually with a very slight convexity seen from above); subnarial swellings moderate; nostrils small; sides of snout with a very slight slope to edge of lip; the canthus rounding; a groove or depression from behind eye, bends down and back to connect with the transverse



PLATE LXXX. *Magnadigita cerroensis* sp. nov. Type. K.U.M.N.H. No. 29961. Cerro de la Muerte, 7000 ft. elevation on highway about 2 km. below Millville, Costa Rica. Total length, 114.5 mm.

groove that crosses the jaws and curves slightly forward across the throat; a well-defined, nearly-straight gular fold passes across the neck; nuchal grooves arising from the edges of the gular fold indistinct, not reaching the middorsal line; posterior extension of epibranchial cartilage extends above arm, forming a fold reaching to near the third costal groove; anterior part of palate moderately arched, with a minute groove or perforation; choanae oval, the greatest diameter of one in distance between choanae, about 3.5 times (choana on right side somewhat deformed).

Maxillary teeth 22-23 (counting missing teeth), small; teeth on prevomers 11-12, in elevated series separated mesially by a distance equal to that between three teeth, separated from the paravomerine teeth by a somewhat greater distance; paravomerine teeth total about 140, in a single series, the length, 5.5 mm., a little less than twice the width (3 mm.); mandibular teeth 34-36, relatively small. The premaxillary teeth 3 (possibly 5 normally), somewhat larger than the maxillary series; tongue free, no trace of a sublingual fold.

Arms and legs strong, separated, when adpressed, by approximately two costal folds; hand webbed with first finger completely in web, second with one joint, the two outer with one and one-half joints free; the webbing somewhat emarginate between digits; the sides of the fingers not parallel or emarginate; three outer toes with one and one-half phalanges free, the second with one, the inner completely enclosed with web; adpressed limbs separated by approximately two costal folds; tail shorter than snout-vent length, slender, cylindrical; the caudal grooves not clearly discernible but approximately 27 grooves (vertebrae); tail slightly constricted at base. Cloaca with strong, chiefly longitudinal, folds; a postiliac gland in evidence, lighter in color than surroundings; approximately 13 costal grooves and 12 folds (there is some doubt that this is the actual count, since the grooves are poorly defined).

Measurements of type in mm.: Total length, 114.5; snout to vent, 62; snout to forearm, 16; axilla to groin, 32.6; tail, 52.5; width of head, 9; head length, 13.6; arm, 13.5; leg, 14.3; head width in snout-vent length, 6.8 times; head length in snout-vent length, 4.56 times.

Color: Above the basic color is cream with brownish stippling and streaking, giving a general brownish coloration; posteriorly the streaks are longitudinal; sides a little darker than back; lavender brown on chin, venter and underside of tail, with numerous cream markings; underside of limbs mottled brown and cream; tail above darker; upper eyelid blackish.

Remarks: The species occurs in the same locality where *Magnadigita pesrubra* is the common species, but the latter may readily be distinguished by the reddish limbs and chin, the distinctness of the costal grooves, and the longer tail having 34-36 caudal grooves (vertebrae), (the estimated number for *cerroensis* being 27).

From *Magnadigita nigrescens*, it differs chiefly in dental and foot characters, *nigrescens* having only the terminal phalanges of the three outer fingers and toes free, and the dentition reduced—the maxillary teeth being 7-9, instead of 22-23 in equal sized specimens of *cerroensis*. (The tail in the type of *nigrescens* has been reproduced.)

The head is distinctly wider than that in *pesrubra* of equal snout-vent length and the color is different. It differs from *subpalmata* in the shorter tail (tail practically equal to snout-vent length in *subpalmata*), different coloration, a smaller series of maxillary teeth, 22-23 (36-40 in largest *subpalmata*), smaller mandibular series, 34-36 (44-50 in *subpalmata*), fewer caudal grooves, 34-35 (compared with 42-44 in *subpalmata*). Differences of size and color markings between this form and *robusta* are such as to distinguish the two readily.

Magnadigita robusta (Cope)

Plate LXXXI

Oedipus robustus Cope, Proc. Acad. Nat. Sci. Philadelphia, 1894, pp. 194-195 (type locality "Faldas of Volcano Irazú" from J. P. Cooper, No. 226 [now AMNH 5464]); Dunn, Field Mus. Nat. Hist., Zool. Ser., vol. 12, no. 7, May 19, 1924, pp. 99, 100 (key); The Plethodontidae, Smith College Publ., Northampton, Mass., 1926, pp. 362-364, 439.

Spelerpes bocourti Boulenger, Proc. Zool. Soc. London, 1898, p. 478 (listing only), (*nec. Brocchi*, Étude sur les Batraciens; Miss. Sci. Mexique livr. 3, 1883, pp. 111-112, pl. 18, f. 2); Günther, Biologia Centrali-Americana; Reptilia and Batrachia, Jan. 1902, p. 301, pl. 76, fig. A (*nec. Brocchi*, *loc. cit.* Günther gives a figure of a specimen from La Palma, Costa Rica; lists specimens from La Palma, 1600 meters, and Cariblanco collected by Bolly and C. F. Underwood).

Magnadigita robusta Taylor, Univ. Kansas Sci. Bull., vol. 30, pt. 1, May 15, 1944, p. 218 (*robusta* referred to the genus *Magnadigita*); *idem*, vol. 33, pt. 1, Apr. 20, 1949, pp. 279, 280, 281.

Diagnosis: This species, the largest salamander known in Costa Rica, may readily be distinguished from other Costa Rican salamanders by its black color, more or less uniform over the entire surface save for a whitish or cream ring around the base of the tail, and some reddish brown or gray flecking on the tail and limbs; maximum size, 110 mm.

Description of species: From K.U.M.N.H. No. 25071, Isla Bonita, Volcán Poás. The head (18 mm.) broad, the outline slightly

angular, reaching its greatest width immediately behind eyes; the neck strongly narrowed, its width 14 mm.; gular fold curving forward very slightly on neck; nuchal grooves more or less distinct to median dorsal line; snout short; length of eye at least a fifth longer

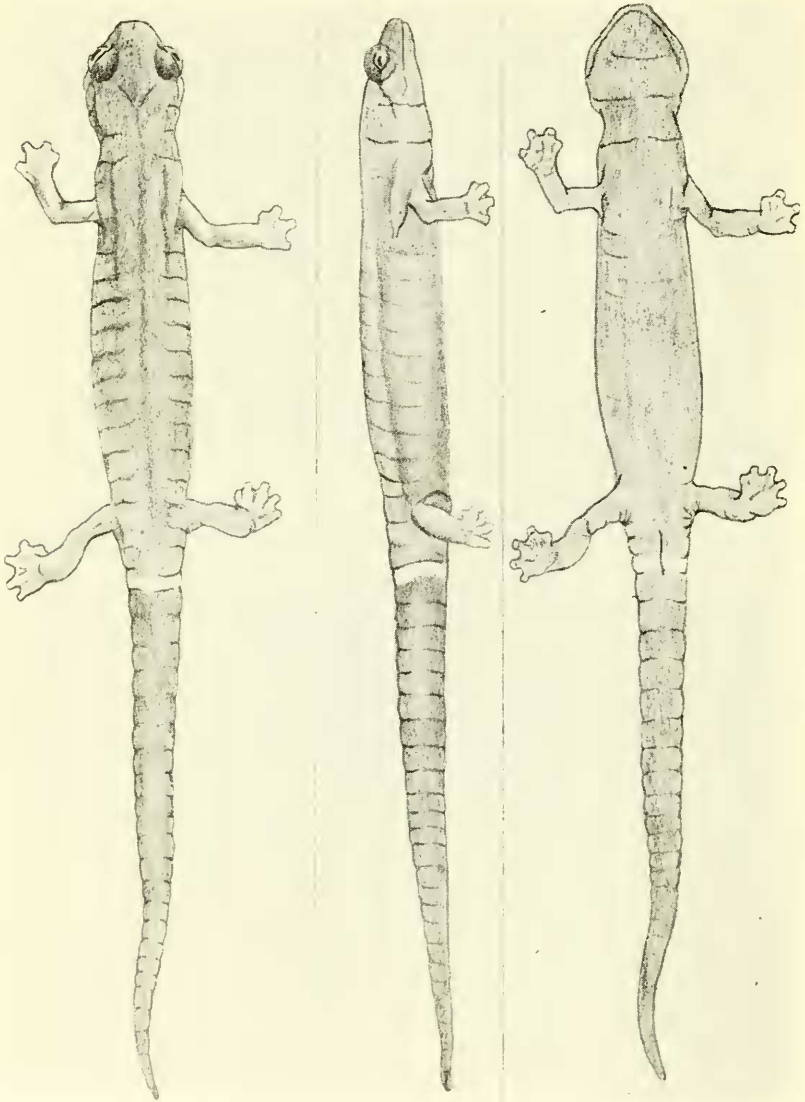


PLATE LXXXI. *Magnadigita robusta* (Cope). K.U.M.N.H. No. 25071. Isla Bonita, eastern slope Volcán Poás, Costa Rica. Total length, 209 mm.

than snout, and equal to distance from eye to middle of tip of snout; tip distinctly truncate, canthal region rounding; under a lens, minute pits on dorsal surface of head visible; interorbital area somewhat corrugated; a groove arising on side of head passes across throat curving forward slightly on ventral surface (in some of the specimens this groove cannot be traced across the throat); a distinct postorbital groove curving back and down from eye, crossing head groove but not reaching as far as the lateral nuchal groove; lateral extension of epibranchial cartilage above arm forms an elevated fold to second costal groove; tongue free, without trace of a sublingual fold; choanae small, the diameter of one in distance between them, five times.

Maxillary teeth 51-53, relatively small, the series separated from premaxillary series by a narrow hiatus; vomerine teeth 20-21, in two elevated series beginning beyond outer level of choanae, the series curving slightly forward then back slightly, mesially separated from each other by a space equal to that between two teeth; paravomerine teeth seemingly in a single group (actually two groups closely approximated, slightly notched behind) separated from vomerine series by a narrow space; palate with a minute medial perforation (opening of gland situated on top of head); limbs large, when adpressed, separated by 3.5 costal folds (limbs in males and younger specimens may be separated by only 2.8 to 3 costal folds); hands and feet broad, the three or four outer toes about half webbed, their broad truncate tips free; inner finger and toe not free; a postiliac gland, whitish in life; tail slightly shorter than head and body (certain other large specimens have the tail slightly longer than body); thirteen costal grooves present, the first somewhat obscured.

Color: Head and body nearly uniformly black with a few flecks of light red-brown on limbs, and some gray or cream flecks on sides of tail and under tail. Ventral surfaces black or slate black; base of tail surrounded by a cream ring.

Measurements in mm.: (see table).

Remarks: Specimens were found chiefly in rotting logs and stumps; however, two were taken under trash, and one under a fallen palm. They were sluggish in their movements and sometimes permitted themselves to be picked up without showing fear or making an effort to escape.

An examination of the stomach of the specimen here described disclosed numerous ants and beetles recently ingested.

TABLE OF MEASUREMENTS AND DATA FROM MAGNADIGITA ROBUSTA

COLLECTION	KUMNH		KUMNH		RCT		RCT		RCT		RCT		RCT	
	Isla Bonita	Isla Bonita	Isla Bonita	Isla Bonita	Isla Bonita	Isla Bonita	Cervantes	Isla Bonita	Cervantes	Isla Bonita	Cervantes	Isla Bonita	Cervantes	Isla Bonita
Locality	25074	25071	663	662	1027	1434	1026	1433	289	1433	1432	1433	1432	1432
Number	110	107	105	105	95	78	66	40	59.5	40	37	40	37	37
Sex	29	28	28	27	25	22	19	13	17	13	12	13	12	12
Snout-vent length	63	59	58	61	54	46	34	21	32	21	20	21	20	20
Snout to foreleg	112.5	103	111	96	106	91	65	31	48.5	31	25	31	25	25
Axilla to groin	22	22	22	20	20	17	15	8	12	8	8	8	8	8
Tail	22	23	23	21	20	20	17	8	13	8	8	8	8	8
Arm	19.5	18	16	18	15	13	16	6	10	6	7	6	7	7
Leg	23	23	22	21	19	17	16	5	13	5	5	5	5	5
Head width	.....	.....	5.6	5.8	6.25	5.77	5.5	5.88	5.66	5.88	5.3	5.88	5.3	5.3
Head length (ocular fold)	.....	.....	4.65	4.62	4.8	4.5	4.1	4.2	4.66	4.2	4.6	4.2	4.6	4.6
Head length in body length	.....	.....	4.86	4.8	4.63	4.6	4.4	4.88	4.88	4.8	4.4	4.88	4.4	4.4
Head length in body length	.....	.....	4.77	4.5	4.4	4.4	3.9	4.8	4.57	4.8	4.1	4.8	4.1	4.1
Arm in body length	.....	.....	4.57	4.4	4.4	3.9	3.88	4.8	4.57	4.8	4.1	4.8	4.1	4.1
Leg in body length	.....	.....	13	13	13	13	13	13	13	13	13	13	13	13
Costal grooves	.....	.....	49-49	46-46	43-42	34-36	30-31	15-14	30-28	15-14	14-14	15-14	14-14	14-14
Maxillary teeth	53-52	51-53	10	11	.....	4	4	1	5	1	3	1	3	3
Premaxillary teeth	10	7	10	11	.....	4	4	1	5	1	3	1	3	3
Premaxillary teeth	20-18	20-21	19-17	18-19	15-16	14-14	17-15	9-10	20-13	9-10	7-6	9-10	7-6	7-6
Paraxillary teeth	199-199	200-212	157-157	188-188	134-132	112-112	74-74	50-50	88-88	50-50	57-57	88-88	57-57	57-57
Mandibular teeth	66-66	64-64	63-63	56-56	54-54	42-42	38-38	23-23	.....	23-23	17-17	23-23	17-17	17-17

Specimens are available from the following localities: Cervantes, 5000 ft., K.U.M.N.H. 1, R.C.T. 3; Isla Bonita, 5600 ft., K.U.M.N.H. 7, R.C.T. 5.

The known distribution of this species includes the following localities: La Palma (in depression between Volcán Irazú and Volcán Barba, *circa* 6000 ft.); Carillo, northeast of Volcán Barba (elevation ?); Rancho Redondo, northwestern slope of Volcán Irazú (5000 ft.); Navarro, south of Cartago ("collections were made in forests up to 6000 ft."). The elevation of Carillo is approximately 1500 ft., but I surmise that the specimen came from a considerably higher elevation nearby.

The species seems to be largely confined to the central group of volcanoes, specimens being usually found at an elevation of between five and six thousand feet.

Collecting in the Talamanca Mountain chain disclosed no specimens; and it may be doubted that the species occurs in that range. However, specimens reported from Navarro suggest that the species may occur, since this locality is south of the drainage of the Rentazón and there is little break in the elevation between the mountains near Navarro and the southern mountain range.

Genus BOLITOGLOSSA Duméril, Bibron and Duméril

Bolitoglossa (*part.*) Duméril, Bibron and Duméril, *Erpétologie Générale*, vol. 9, 1854, p. 88.

Type of genus: *Bolitoglossa mexicana* Duméril, Bibron and Duméril [= *Salamandra platyductyla* Gray].

The number of species of this genus occurring in Costa Rica is probably six.

KEY TO COSTA RICAN SPECIES OF BOLITOGLOSSA

1. A ridge or fold crossing frontal region and eyelids; the maxillary teeth greatly reduced or absent *colonnea*
 No ridge or fold across frontal region; maxillary teeth usually numerous 2
2. Vomerine teeth in two elevated ridges, the teeth arranged in more than a single series tending to form a patch *palustris*
 Vomerine teeth on two elevated ridges in a single series not tending to form a patch 3
3. Dorsal surface light cream, with darker pigment forming indefinite stripes on the dorsum, and to a lesser extent on venter *striatula*
 Dorsal surface lacking stripes; a dark lateral stripe may be present, 4
4. Sides of body, tail and ventral surfaces blackish; dorsal surface yellowish or orange, on which there may be two or three ir-

- regular blackish lines or lines broken into small separate spots;
 costal grooves strongly defined *platyductyla*
 Ventral surfaces not black; no black dorsal stripes or linear series
 of black dots; grooves variable..... 5
5. Venter cream without markings; dorsum with irregular cream
 lines dark edged or dark-edged cream spots on a lavender
 ground color; costal grooves distinct *flaviventris*
 A grayish black lateral band; venter pigmented with fine whitish
 flecks or very short longitudinal lines; costal grooves rather in-
 distinct *lignicolor*

[*Bolitoglossa platyductyla* (Gray)]

Salamandra platyductyla Gray, Supplement, in Griffith and Pidgeon, Cuvier's Animal Kingdom, vol. 9, 1831, p. 107.

Bolitoglossa platyductyla Taylor, Univ. Kansas Sci. Bull., vol. 30, 1944, p. 219.

Speleperes variegatus Günther, Biologia Centrali-Americana; Reptilia and Batrachia, Jan. 1902, p. 302 (*part.*), (reports a specimen in Natural History Museum, labeled *Speleperes morio*, as belonging to this species. Underwood coll.); ? Cope, Proc. Amer. Philos. Soc. vol. 31, 1893, p. 335 (Buenos Ayres, Costa Rica).

Oedipus platyductylus Dunn, The Salamanders of the Family Plethodontidae, Smith Col. Publ., 1926, pp. 400-405, 440-441 (*part.*). (A specimen mentioned in the British Museum from San Carlos is stated to be "*certainly platyductylus*"; two specimens in the British Museum are reported from Medellín, Colombia.)

The confusion of species under the names *platyductyla* and *variegata* is considerable. I have seen no specimen of this species or closely related forms from Costa Rica. Dr. Emmet Reid Dunn, who examined the Günther specimen from San Carlos states that it "is certainly *O. platyductylus* rather than any other described form. It has a rather broken dorsal light band."

Until specimens of the San Carlos form are rediscovered in Costa Rica, the place of this name, for a species in the fauna of Costa Rica, must be uncertain. Dunn has placed certain species, recognized by subsequent authors, in the synonymy of *platyductyla*.

Bolitoglossa flaviventris (Schmidt)

Oedipus flaviventris Schmidt, Zool. Ser. Field Mus. Nat. Hist., vol. 20, 1936, pp. 148-150 (type locality, Chicharras, Chiapas, Mexico).

Bolitoglossa flaviventris Taylor, Univ. Kansas Sci. Bull., vol. 30, 1944, p. 219 (Tonolá).

Speleperes salvinii Brocchi (*nec Gray*), Mission Scientifique au Mexique et dans l'Amérique Centrale; Étude des Batraciens de l'Amérique Centrale, livr. 3, 1883, p. 117, pl. 18, figs. 3, 4.

Oedipus salvinii Dunn, The Salamanders of the Family Plethodontidae. Smith Col. Publ., 1926, pp. 405-408, map 74 (*part.*); Taylor, Univ. Kansas Sci. Bull., vol. 25, 1938 (1939), pl. 28, figs. 2, pp. 296-297.

The species is included in the Costa Rica fauna on the basis of specimens from Miravalles and Banana, C. R.

Diagnosis: A medium-large form, the snout-vent length reaching 86 mm.; the tail 90 mm.; digits completely webbed, the front outline of hand and foot appearing scalloped; vomerine teeth in two curving series of usually 15-17 teeth each, almost meeting mesially; head wider than body, flattened, truncate, its width in snout-vent length 6.75 to 7.75 times. Lavender-brown with a brown bordered cream dorsolateral stripe, and a similar median stripe; stripes may be broken into spots.

Description of species:—(U.S.N.M. No. 37772, Marivalles, Costa Rica). Head truncate oval, a little wider than body its width in snout-vent length approximately 7.6 times; length of eye slightly greater than its distance from nostril; posterior part of eyelids inserted under a diagonal fold; a subnarial swelling on lip; the angle of the jaw extends considerably behind back level of eye; a strong gular fold present, the nuchal groove arising from it can be traced up a short distance on side of neck; a groove from side of head crosses jaw angle and chin; a weak postorbital groove reaches down and back to the beginning of nuchal groove; 13 costal grooves, counting one in axilla and groin; a very large submental bedonic gland; no sublingual fold (the floor of the mouth has been injured and that which appears to be a fold is not so); vomerine teeth 9-10, beginning beyond outer level of choanae, curve in diagonally and are separated mesially by a space equal to less than diameter of a choana; maxillary teeth present, the number approximately 18-18 counting spaces where teeth are missing; 2 premaxillary teeth pierce the gum (perhaps a third has been present); paravomerine teeth in a single patch, notched behind; mandibular teeth 18-18.

Limbs strong, the hands and feet flattened, fully webbed with the tips of digits giving their outer edges a scalloped appearance; when adpressed, the limbs separated by a little less than four costal folds.

Color: Generally lavender-brown; on each side of back a sinous white (cream) stripe bordered above and below by brown; a similar median stripe; tail white above with rounded brown spots, the white, bordered laterally with brown; venter, chin and throat white (cream).

Measurements in mm.: Snout to end of vent 61.5; width of head 8.1; length of head 12; tail 56.8; arm 15.2; leg 17.

Remarks: The described specimen is faded and somewhat softened and certain details are obscured. I have referred the specimen

to *flaviventris* largely on the basis of the immaculate ventral surfaces. That the reduced number of vomerine teeth in this specimen is significant, is doubtful.

I have seen a female specimen from Banana, Costa Rica, that has slightly longer legs separated by only 1 to 2 costal folds; there are 8 premaxillary teeth, none piercing the lip, but standing near the edge of the lip. The dorsolateral stripes are broken up into spots. The small number of specimens from these southern localities throws little or no light on the relationship of *Bolitoglossa flaviventris* and *Bolitoglossa salvinii*. The species is frequently found on banana plants or in bromelias.

Bolitoglossa lignicolor (Peters)

Spelerpes (Oedipus) lignicolor Peters, Monatsb. König. Akad. Wiss. Berlin 1873, p. 617 (type locality, Chiriquí, Panamá, H. Ribbe coll.); Sitzungsb. König. preus. Akad. Wiss. Berlin, 1882, p. 117.

Oedipus lignicolor Dunn, Zool. Ser. Field Mus. Nat. Hist., vol. 12, 1924, pp. 99, 100; Salamanders of the Family Plethodontidae, Smith Coll. Publ., 1926, pp. 410-413 (*part.*); Copeia, 1937, No. 3, p. 163 (Boquete [Panamá]); Proc. Acad. Nat. Sci. Philadelphia, vol. 92, 1940, p. 105 (Puerto Armuelles, Panamá; states that he thinks *Oedipus ahli* Unterstein "a straight synonym"). *Spelerpes lignicolor* Günther, Biología Centrali-Americana; Reptilia and Batrachia, Jan. 1902, pp. 302-303 (Chiriquí, Panamá).

Diagnosis: A form related to *Bolitoglossa yucatanana* and *Bolitoglossa palustris* but having the vomerine teeth in two series, not reaching outer end of choanae, and the teeth in each, in a single row. The tail is slightly shorter, equal, or slightly longer than head and body; a grayish-black lateral band reaching high on sides is continuous with the dark ventral coloration. Venter with fine whitish flecks or short longitudinal lines.

Description of species: Head width contained in snout-to-vent length approximately $5\frac{1}{2}$ times; eye shorter than its distance from tip of snout; a pair of subnarial swellings, larger in male than female; vomerine teeth 11-14 in two series, the teeth in each in a single row, beginning near middle of choanae, curving in and back, and separated from its fellow by width of a choana; paravomerine teeth in a single patch, notched behind; 13 costal grooves, usually not very distinct.

Maxillary teeth from as few as 6-6 (U.S.N.M. No. 58491 Boquete, Panamá) to 24 in another Panamá specimen from Chiriquí; no sublingual fold; the groove from eye to the nuchal fold obsolete, sometimes present for a short distance behind eye; a gular fold, but there is no white line concealed by it; a glandular spot (lavender) behind insertion of hind limb; arms and legs separated by $2\frac{1}{2}$ to 3

costal folds, when adpressed; the epibranchial cartilage forms a fold, distinct the length of two costal folds behind posterior level of arm insertion; eye nearly a third longer than the axial snout length; tail constricted at base.

Color: (from types). Above, from snout to tip of tail, yellow brown, speckled with darker pigment, which here and there forms lines; in one of the two cotypes there is a mid-dorsal line on neck that divides anteriorly. Below and on sides, color grayish black sharply set apart from color of dorsum, and sprinkled more or less with small white or yellow flecks which on under side of neck and chin region unite to form fine longitudinal lines.

Measurements in mm.: (type specimen). Total length 100; tail 48; head to end of vent 52; head width 9.5; head length 9.5; snout to arm insertion 17; axilla to groin 29; arm 12; hand 4; leg 13.5; foot 5.

Remarks: A specimen from Chiriquí, Panamá, is described as follows by Günther (*loc. cit.*): Tail cylindrical longer than head and body; the series of palatine [vomerine] teeth nearly meet in the middle and do not extend outwards beyond choanae; black of back forming indistinct longitudinal bands. throat and chest with minute whitish specks. The type description omits many important characters. Peters states that the teeth [vomerine teeth and paravomerine teeth] are similar to a published figure of *Spelerpes Belli* save that there is but a single series of paravomerine teeth. Since in the figure the vomerine teeth are in a single continuous line, one presumes that this condition obtains in the type of *lignicolor*. The two chief characters, which seem to separate *Bolitoglossa palustris* from this species is that each of the ridges has the vomerine teeth arranged in a patch or multiple series, rather than in a single line, and the tail is much shorter than head-body length (approximately .7).

Dunn reports a Costa Rican specimen from Sarapiquí in his discussion of *lignicolor* (*loc. cit.*) that has the vomerine teeth in a patch. I suspect that the badly mutilated specimen, A.M.N.H. No. 11725, may be a specimen of *palustris*. The bones however are green in color, and this is not true of the bones of *palustris*. It may be significant that *yucatanana* has the vomerine teeth similarly arranged.

Bolitoglossa palustris Taylor

Plate LXXXII

Bolitoglossa palustris Taylor, Univ. Kansas Sci. Bull., vol. 33, pt. 1, Apr. 20, 1949, pp. 283-284 (type locality, San Isidro El General, Costa Rica, E. H. Taylor, coll.).

Diagnosis: A member of the rufescens group, with a short broad head; fully webbed or palmate hand and foot; vomerine teeth total 34 on two strongly-elevated ridges, in more than a single series, beginning about level of middle of choanae; choanae large; maxillary teeth 14-14; premaxillary teeth 4; no free sublingual fold under tongue; costal grooves indistinct, probably 13; tail shorter than head and body.

Description of type: Snout moderately short, truncate, moderately elevated above the mouth; subnarial swellings small, distinct; nostril small; canthus rostralis rounded, the loreal region sloping abruptly to lip; diameter of eye greater than length of snout, about equal to its distance from middle of tip; surface of snout on a level with interorbital and occipital surfaces; interorbital width, equal to twice width of eyelid; upper eyelid not overlapping lower, behind eye, the ends not fitting in a small groove; a postorbital groove or depression reaching back to a vertical groove from side of chin which crosses the angle of jaw but fails to reach the top of head, nor is it continuous across chin; a very well-defined gular fold, but nuchal grooves from ends of fold not or scarcely traceable on sides of neck, and definitely not reaching to median nuchal line; angle of mouth reaching slightly behind posterior level of orbit; posterior extension of epibranchial cartilage forming an elevated fold which reaches back of arm insertion, half the length of arm.

Maxillary teeth 14-14 (possibly two or three more as evidenced by breaks in the continuity of the series); 4 premaxillary teeth; vomerine teeth 16-18, in two series (each arranged in more than a single irregular row) beginning at the level of middle of choanae, and curving slightly, separated mesially by a distance equal to greatest diameter of choana; their diameter contained in distance between them, three and one-half times; paravomerine teeth in a single subtriangular patch, the length only about a third greater than width, not notched behind, separated from the vomerine series by a distance greater than half distance between choanae; teeth strong forming typical chevron-shaped series; some pigment in evidence in anterior palatal region, at side of paravomerine teeth and on floor of mouth anterior to tongue.

Dorsal surface of back rather rough; side and venter smooth; costal grooves rather indistinct, seemingly 13 present; adpressed limbs separated by $3\frac{1}{2}$ folds; a constriction at base of tail; 25 caudal grooves present; tail tetragonal in cross section, compressed pos-

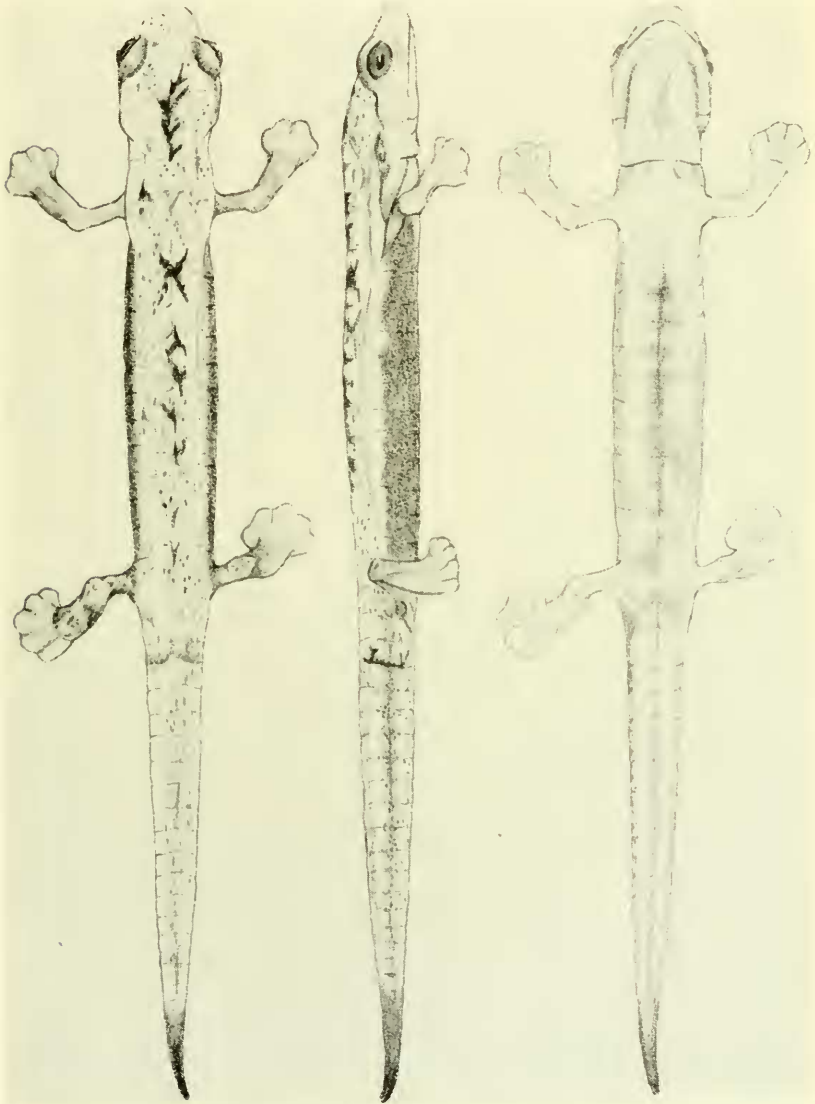


PLATE LXXXII. *Bolitoglossa palustris* Taylor. Type, K.U.M.N.H. No. 23817, San Isidro El General, Costa Rica. Total length, 81.8 mm.

teriorly, with a subcaudal groove present; anal folds present on sides of cloaca; small glandular area behind insertion of hind limb, dark in color.

Color: In life, above entire dorsal surface of head and tail buff to fawn with minute irregularly scattered flecks of brown, and some few very small irregular spots, that on back of occiput most distinct; dusky low on sides of neck and body (under a lens the black pigment is nearly uniformly distributed save for some minute dashlike areas where pigment is wanting); venter dusky, but lighter than sides, with numerous very narrow, more or less elongate lighter spots; sides of tail lighter than body but with some brownish flecks.

Measurements in mm.: Total length, 81.8; snout to vent, 48.8; tail, 33; snout to arm insertion, 14; snout to gular fold (median), 12; width of head, 8.3; axilla to groin, 25.3; arm, 11.1; leg, 11; width of head in snout-vent length, 5.88 times.

Remarks: In the original description, the loss of a page from the submitted manuscript is responsible for the absence of the color characters and measurements of the type. See comments under *Bolitoglossa lignicolor*.

Bolitoglossa striatula (Noble)

Plate LXXXIII

Oedipus striatulus Noble, Bull. Amer. Mus. Nat. Hist., vol. 38, pp. 344-346, pl. 19 (type locality, Cukra, eastern Nicaragua, Halter and Mannhardt collectors, AMNH No. 6999 [specimens also reported from Chontales Mountains, Mt. Mombacho, Nicaragua, and Turrialba, Costa Rica]); *idem*, vol. 44, p. 2; Dunn, Field Mus. Nat. Hist., Zool. Ser., vol. 12, no. 7, May, 1924, pp. 99, 100 (key); The Plethodontidae, 1926, pp. 416-418, map, fig. 78 (type series; also two specimens listed from Surubres, Costa Rica).

Bolitoglossa striatula Taylor, Univ. Kansas Sci. Bull., vol. 30, pt. 1, May 15, 1944; pp. 195, 219-222; *idem*, vol. 33, pt. 1, April 20, 1949, pp. 279, 280, 281.

Diagnosis: Medium-sized salamanders (62 mm.); costal folds 13, not strongly marked; vomerine tooth rows arranged in a single line; vomerine teeth total 22-24; maxillary teeth in large adults total 38 to 46. Color on dorsum buff or fawn, with dark pigment arranged in longitudinal lines or stripes; lighter beneath but some lineation evident.

Description of species: (From R.C.T. No. 127.) Head large, broader than body; snout gently rounding and extending beyond mouth for 1.2 mm.; eye length (edge of upper eyelid) slightly longer than snout, but not quite equal to distance from eye to the median tip of snout; dorsal surface of head nearly flat; interorbital

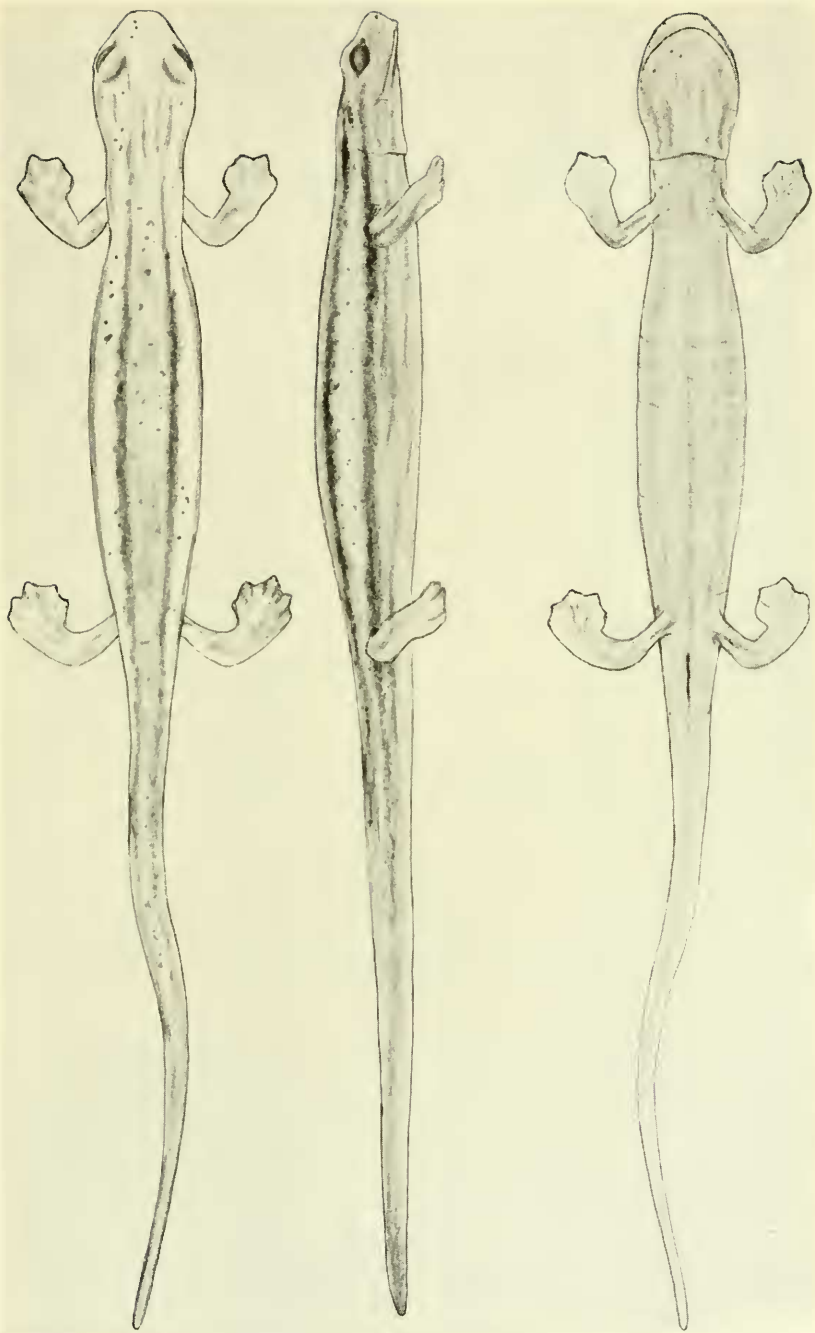


PLATE LXXXIII. *Bolitoglossa striatula* (Noble). R.C.T. No. 127. Turrialba, Costa Rica. Total length, 123.5 mm.

TABLE OF MEASUREMENTS AND DATA ON BOLITOGLOSSA STRIATULA

COLLECTION	RCT		KUMNH		RCT		KUMNH		RCT		KUMNH	
Number.....	127		25076		1431		25077		1427		25079	
Sex.....	0	1425	0	1431	0	1427	0	1427	0	128	25081	
Snout to vent.....	62	62	58-6	53-5	5	51	53-2	50	50	50	34	
Snout to foreleg.....	37	37	37	29	16	29.8	36	34.6	17	17	41	
Axilla to groin.....	01.5	06	09.4	02.5	29	30.5	30	28.6	27.5	27.5	14	
Tail.....	12.2	12.6	12.8	12	02.5	50.5	57	52	50	50	20	
Arm.....	12.5	13.6	12.7	12	12	11	12	11	10.5	8	8	
Leg.....	13.5	13	13	12	12	11	12	11	11	11	8	
Head to gular fold.....	6.3	6.9	6.9	6	8	8	8.2	8	8	8	8	
Head width in length.....	4.38	4.8	4.5	4.4	12.2	11.3	11.3	11.3	11.3	11.3	16.2	
Head length in length.....	13+	13	13	13	6	6.3	6.48	6.2	6.1	6.1	8.3	
Costal grooves.....	19-19	13	13	4	4	4	4	4	4	4	6.2	
Maxillary teeth.....	3	15-19	23-21	22-23	13	13	13	13	13	13	9.7	
Premaxillary teeth.....	11-12	12	11	5	18	18	18	18	18	18	12-13	
Prevomarine teeth.....	99-99	101-102	87-87	95-97	12-11	8-11	12-10	7-9	9-7	9-7	10.8	
Paravomarine teeth.....	37-36	41-38	37-38	40-41	35	35	35	35	35	35	62-68	
Mandibular teeth.....											30-32	
											84-86	
											37-36	
											23-24	

width 1.7 times transverse width of upper eyelid; posterior ends of eyelids tucked under a diagonal fold; postorbital groove not discernible (evident in certain specimens but never clearly defined); groove crossing end of jaws cannot be traced on chin save as a very slight depression; gular fold across throat curving forward very slightly; lateral nuchal grooves arising from ends of gular fold absent or not clearly defined.

Maxillary teeth rather small, 19-19; premaxillary teeth 5; vomerine teeth 11-12 in two elevated, arched series, curving back mesially and separated by space equal to that between two teeth; mandibular teeth 37-36; paravomerine teeth 198 in a single compact patch (convex rather than flat), the teeth arranged more or less in chevrons (new teeth being added laterally and anteriorly); palatal area anterior to the prevomers vaulted with a minute median opening; choanae large, the diameter of one choana in distance between choanae about 3.7 times; tongue free, papillate; lacking a sublingual fold.

Costal folds and grooves dim or obsolete (13 grooves present and 12 folds normally present); behind arm, grooves obscured by the posterior extension of the epibranchial that reaches above the arm forming a distinct elevated fold; tail (61.5 mm.) very slender and somewhat compressed, about equal to distance from snout to vent (61 mm.); 26 + costal folds, the terminal portion of tail being undifferentiated; width of head (9.5 mm.) in snout-vent length, 6.5 times; head length to gular fold (13.6 mm.), in snout-vent length, 4.58 times.

Hand and foot palmate, the digit tips slightly triangular, with slight emarginations between toes; arm and leg when adpressed separated by 2.5 to 3 costal folds; postiliac gland absent or indiscernible.

Color: Body yellowish to cream; a broad median brownish cream stripe bordered laterally by a dark streak; dorsolateral cream stripe bordered below by a broad brownish stripe edged with black where it borders the cream; venter with two narrow outer dim longitudinal streaks and a median dim darker streak; some black dots or streaks on back of head, on the middorsal stripe and on tail; some trace of the body marking may extend onto the tail.

Measurements in mm.: (See table).

Variation: Males probably do not attain the maximum size of females. On the chin the hedonic gland is in evidence but it is not strongly differentiated since the glandules of the skin in that region are somewhat larger and thicker than elsewhere. The areas

about the nostrils are much swollen, the tip of the snout being swollen and sharply truncate. The maxillary teeth are a little larger than those in females and the premaxillary teeth are very much larger and farther forward, piercing the lip, and visible when the mouth is closed.

All specimens were taken at the farm of the Inter-American Institute of Agriculture. There are five specimens in the R.C.T. Collection.

Remarks: Specimens were taken in daytime from under piles of grass and weeds. At night they were found crawling about on shrubs or vines not far from the margin of a pond, or on the vegetation above rainpools. They were active especially on rainy nights.

Thirteen specimens are at hand, all captured on the I.A.I.A. Farm at Turrialba. I believe that this town and Surubres are the only known localities for the species in Costa Rica. This is perhaps surprising since the species is known from several localities in Nicaragua.

Bolitoglossa colonnea (Dunn)

Plate LXXXIV

Oedipus colonneus Dunn, Field Mus. Nat. Hist., Zool. Ser., vol. 12, no. 7, May 19, 1924, pp. 96-97 (type locality, La Loma, on trail from Chiriquicito to Boquete, 2000 ft., Bocas del Toro, Panamá); The Plethodontidae, Smith College Publ., Northampton, Mass., 1926, pp. 420-422 (type only listed with one other questionably identified specimen).

Bolitoglossa colonnea Taylor, Univ. Kansas Sci. Bull., vol. 30, pt. 1, May 15, 1944, p. 219 (referred to *Bolitoglossa*).

Diagnosis: A small species with a small ridge or fold across forehead and eyelids. Maxillary teeth greatly reduced or absent; costal grooves very indistinct or absent; adpressed limbs separated by a distance of 10 mm.

Description of species: (K.U.M.N.H. No. 29966 ♀). Head as wide as body, with a slight nuchal constriction; snout truncate seen from above, the edge extending .7 mm. beyond mouth; nostrils small with strongly-swollen areas below nostrils forming slight projections; snout surface corrugated or roughened, with small elevated patches, to a point just back of front level of eyes, where the surface becomes suddenly elevated .2 to .3 mm.; edge of elevation somewhat roughened, uneven, suggesting a fleshy fold, extending onto eyelid; upper eyelid thickened, fleshy, its width in interorbital width 1.6 times. Cloacal walls with strong folds.

A groove or depression from back of eye curves down across posterior angle of jaw and may be traced across the throat; an ample

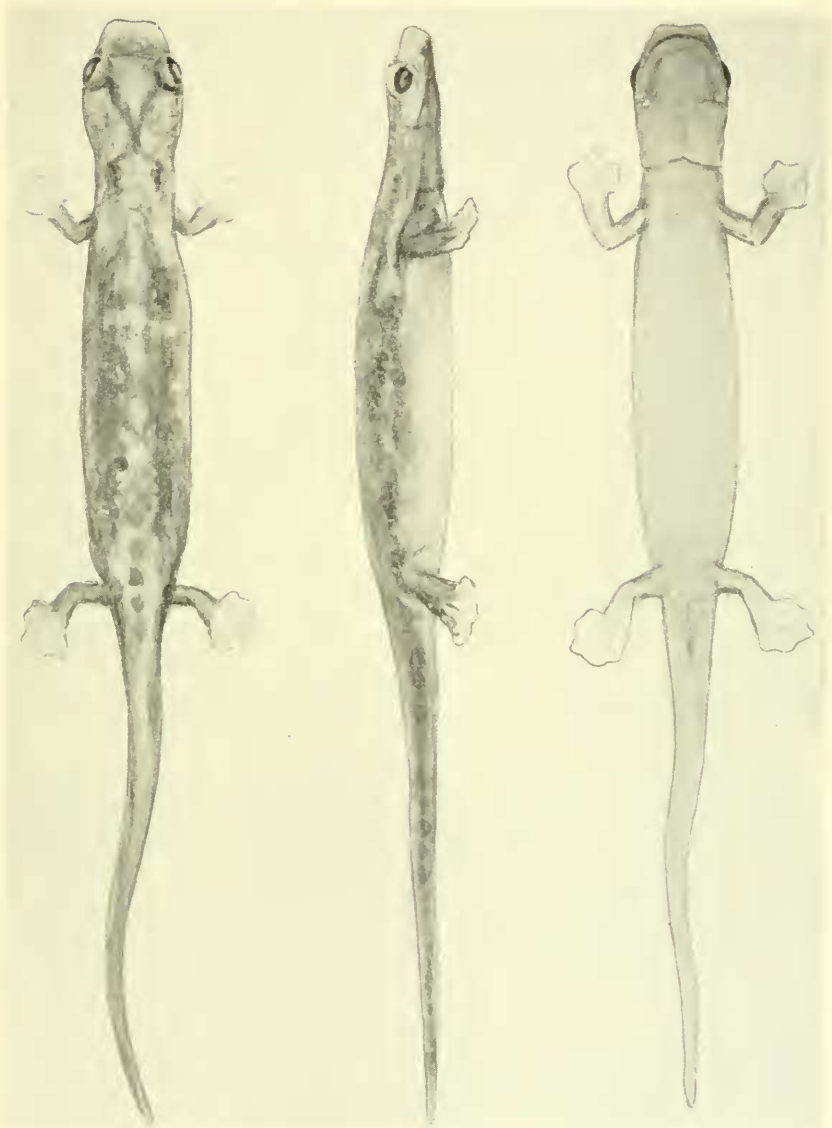


PLATE LXXXIV. *Bolitoglossa colonnea* (Dunn), K.U.M.N.H. No. 29966, Los Diamantes, 1 mi. S Guápiles, Costa Rica. Total length, 86.5 mm.

gular fold (width .5 mm.), the lateral nuchal grooves more or less indicated to middorsal line; posterior extension of epibranchial cartilage reaches above and behind arm insertion a distance of 3 mm.; a fine indistinct fleshy fold or groove passes from eye back along side of neck.

Maxillary teeth absent on one side, two on the other side; premaxillary teeth five; prevomerine teeth 13-13, on two elevated, somewhat arched rows curving back mesially, somewhat irregularly arranged rather than being in a continuous row, separated from the paravomerine teeth; latter in a single regular patch, the teeth numbering approximately 178; mandibular teeth small 30-30; the palatal area in front of the vomerine teeth is not strongly arched, a depression but no distinct perforation evident; choanae moderately large, the diameter of one in interchoanal distance four times; tongue small, free, no trace of a sublingual fold.

Hands and feet completely palmate, slightly emarginate between digits; third finger and toe pointed; limbs when adpressed separated by approximately 10 mm. Costal grooves not evident, the number of vertebrae (which may be counted) suggest the equivalent of 13 grooves and 12 folds; tail thin, compressed toward tip; its length .81 percent snout-vent length; the width of head in snout-vent length 6 times.

Color: Brownish gray above and on sides, streaked with darker; lighter below on venter, the color nearly uniform; markings on head outline a pentagonal area and forming an X-shaped mark; two very indistinct lateral streaks with some mottling on back; arms and legs darker, blackish brown, the hands and feet cream, lightly pigmented.

Measurements in mm.: See attached table.

Variation: A young male, R.C.T. No. 1407, has a sharply truncate snout with large mammalike swellings below the nostril directed somewhat forward, forming the two most anterior points of the snout seen from above; seen from in front or from below one notes

MEASUREMENTS AND DATA ON BOLITOGLOSSA COLONNEA

COLLECTION	KUMNH	RCT	KUMNH	RCT
Number.....	29966	1409	29967	1407
Sex.....	♀	♀	♀	♂
Snout-vent length.....	47.5	40	39.7	29
Snout to foreleg.....	13.2	11	11	8.9
Axilla to groin.....	27	23	22	14
Tail.....	39	38	32	27.2
Arm.....	9	8	9	7
Leg.....	9.8	8	9	7.4
Head width.....	7.9	6.2	6.3	5.6
Head length (to gular fold).....	10.4	9	9	7.5
Head width in body length.....	6	6.48	6.3	5.2
Head length in body length.....	4.57	4.4	4.4	3.9
Arm in body length.....	5.3	5	4.4	4.1
Leg in body length.....	4.84	5	4.4	3.9
Maxillary teeth.....	2-0	6-?	0	0
Premaxillary teeth.....	5	6	2	2
Prevomerine teeth.....	13-13	13-11	12-12	8-9
Paravomerine teeth.....	178	168	168	114
Mandibular teeth.....	30-30	29-29	.....	19-20

a deep depression between the swollen elevations, at the lower level of which two teeth emerge through the lip. The dorsal coloring is lighter, brownish cream, but the markings of the adult are in evidence; cloaca strongly papillate. Another female specimen, R.C.T. No. 1409 (approximately the size of the type), has markings as described here; the upper of the two lateral streaks beginning on neck is deep black at its beginning. The dermal fold or ridge across the head and eyelids is in evidence in all the specimens, the area of the snout in front of the fold being on a lower level than the interorbital and occipital region. The area behind the fold is pentagonal in shape, drawn out to a sharp angle behind, and outlined in darker color in all of the specimens. Six maxillary teeth are present on one maxilla, but I cannot determine whether or not teeth have been present on the opposite side. In K.U.M.N.H. No. 29967, no maxillary teeth can be found. Teeth are said to be absent in the type.

Remarks: This lowland form, originally described from the Caribbean side of Panamá (La Loma, Bocas del Toro), was discovered at Los Diamantes, 1 mile south of Guápiles on the eastern side of Costa Rica. These specimens, four in number, were taken at night either crawling on fallen logs or on plants near a small fast-flowing stream. They were sluggish, and made little struggle to escape when picked up.

GENUS *PARVIMOLGE* Taylor

Parvimolge Taylor, Univ. Kansas Sci. Bull., vol. 30, 1944, pp. 223, 226.

Type of genus: *Oedipus townsendi* Dunn.

There must be some doubt as to the correct generic placement of the following Costa Rican form until its skeletal characters are known. As yet only a single specimen has been taken.

Parvimolge richardi Taylor

Plate LXXXV; text fig. 4

Parvimolge richardi Taylor, Univ. Kansas Sci. Bull., vol. 33, pt. 1, Apr. 20, 1949, pp. 284-285 (type locality, Isla Bonita [American Cinchona Plantation] Volcán Poás, elevation approximately 6500 ft., R. C. Taylor, coll.).

Diagnosis: A member of the genus *Parvimolge*, but differing from *Parvimolge townsendi* in the absence of the series of enlarged dorsal glands, but agreeing in the ossification of the skull and the modification of the digits, diminutive body size, moderately enlarged nostril, presence of maxillary teeth, and absence of an orbitolabial groove.

Snout rather pointed; digits grown together, tips of fingers and toes pointed; tail not constricted at base; chin with an arched groove; nostrils enlarged; thirteen costal grooves; five to six costal folds between adpressed limbs; paravomerine teeth in a single patch,



PLATE LXXXV. *Parvimolge richardi* Taylor. Type, R.C.T. 1436; Isla Bonita, Costa Rica. Total length, 49.5 mm.

not notched behind; vomerine teeth on strongly elevated ridges; twelve maxillary teeth on each side; six premaxillary teeth.

Description of type: (R.C.T. No. 1436). Female; snout bluntly pointed; eye very large, its horizontal diameter a little more than one and two-fifths times length of snout; nostril circular, moderately enlarged; interorbital width about equal to an eyelid; surface of head smooth, the openings of skin glands scarcely evident save in a curved series on forehead, between and partly anterior to eyelids.

Gular fold with an irregular nuchal groove passing up on each side of head and meeting its fellow on the median line; on chin two

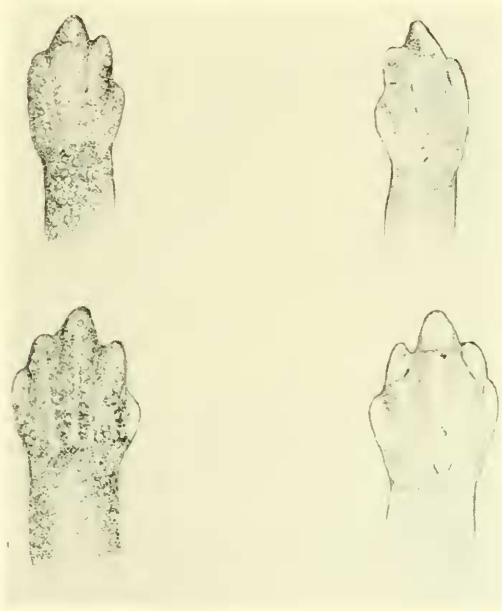


FIG. 4. *Parvimolge richardi*. Type. Upper. Left hand, dorsal and ventral views. Lower. Left foot, dorsal and ventral views.

grooves arching forward (seemingly without a groove across base); on each side of the base, a groove passes up across the angle of the jaw to the dorsal surface of the head, then turns diagonally backward and joins its fellow on middorsal line somewhat in front of nuchal groove; a dim groove runs from eye back to nuchal groove on side of head; thirteen costal grooves; fold caused by posterior extension of the epibranchial cartilage reaching as far as third costal fold; paravomerine teeth form a single elongate patch, widened and rounded posteriorly, coming nearly to a point anteriorly, separated

from vomerine series by a short hiatus; vomerine teeth on two elevated ridges about eight on a side, narrowly separated mesially; maxillary teeth about 12-12 not reaching back as far as middle of eye; six premaxillary teeth; about 16-16 mandibular teeth.

Adpressed limbs separated by six costal folds. Limbs small, weak, the hands and feet small; digits grown together rather than webbed. Third finger proportionately very large, the pointed tip extending more than a third of its length beyond other finger; tip of second finger free, while those of the first and fourth are not or scarcely free. Foot with the first and fifth toes not free; terminal joint of the second and fourth toes free, third toe proportionally large, the tip extending beyond other toes for nearly one third of its length.

Sides of the cloaca with smooth diagonal folds (female).

Color: Above brownish lavender, darker on the head, especially on upper eyelids, dorsally growing lighter to the base of the tail; a very indefinite darker lateral line; lower part of sides as light or lighter than dorsum; under side of chin and abdomen light lavender with very numerous white or cream flecks; anal region light; tail dark with numerous lighter flecks or vermiculations. The small postiliac spot behind insertion of leg scarcely discernible; white flecks below nostril and eye; a white line on tip of snout.

Measurements in mm.: Total length, 49.5; snout to vent, 28; snout to foreleg, 7.6; tail, 22; head width, 4.9; length of head to gular fold (ventral), 5; length to gular fold (lateral), 5.85.

Remarks: This specimen was taken at Isla Bonita near the base of a stump under bark by Richard C. Taylor. It was found in company with *Chiropterotriton abscondens*.

The absence of the enlarged glands on the back show that, while generically related, *Parvimolge townsendi* and *richardi* are widely distinct specifically. The bluntly pointed snout likewise is a differentiating character easily discerned.

Genus HAPTOGLOSSA Cope

Haptoglossa Cope, Proc. Amer. Philos. Soc., Dec. 23, 1893, p. 33.

Type of genus: *Haptoglossa pressicauda* Cope.

Cope originally placed the genus in the subfamily Thoriinae, "hence the vertebrae are opisthocelous and the carpus and tarsus not ossified. Tongue adherent in front and by the middle. Digits not distinct, 4, 5."

The type is lost and its place in the plethodontid salamanders must await its rediscovery.

Haptoglossa pressicauda Cope

Haptoglossa pressicauda Cope, Proc. Amer. Philos. Soc., vol. 31, Dec. 23, 1893, pp. 333-335 (type locality, Palma, Costa Rica, "near the Golfo Dulce" on the Pacific slope); Taylor, Univ. Kansas Sci. Bull., vol. 30, pt. 1, May 15, 1944, pp. 229-230.

Oedipus uniformis Dunn, The Salamanders of the Family Plethodontidae. Smith College Publ., 1926, pp. 427-430 (*part.*).

Diagnosis: A diminutive salamander, 31.5 mm. snout to vent; tail about as long as body (without head); digits not distinct; tongue adherent in front and by the middle; limbs very small; nineteen indistinct costal folds.

Description of species: "Form slender, limbs very small. Length of tail equals that of the body without the head. Length of head contained in that of the body to the vent, seven and a half times; the width less than the length. A gular and nineteen costal folds, the latter not very distinct. Fore and hind limbs each equal to three intercostal spaces. Digits indicated by emarginations of the foot border. Vomerine teeth in two moderately arched transverse series, not produced posteriorly on the middle line, hence well separated from the rather wide single patch of parasphenoid teeth. Tongue rather small, oval. Nostril of moderate size, situated well anteriorly. Eye, large. Tail compressed from near base to apex, with a median dorsal, but no ventral groove, and well-marked vertical grooves."

Color: "Uniform black; underside of head and tail a little paler than other regions."

Measurements in mm.: Total length 62; length to posterior angle of mouth 4; length to fore limb 8; length to hind limb 28.5; length to base of tail 31.5; width of head at angle of mouth 3.

Remarks: Cope states that the species superficially resembles species of *Thorius* and *Oedipina*. Dunn has placed the species as a questioned synonym of *Oedipus uniformis* without adequate reason. The type is presumably lost (Dunn states, "the type has been destroyed"). The species has not been rediscovered.

GENUS OEDIPINA Keferstein

Oedipina Keferstein, Nachricht. Ges. Wiss. Göttingen, 1868 Aug. (*vide* Günther), p. 331.

Type of genus: *Oedipina uniformis* Keferstein.

The genus as here treated has the following species known from territory outside of Costa Rica:

1. *Oedipina elongata* (Schmidt) from Guatemala and southern Mexico.

2. *Oedipina collaris* (Stejneger) a very large species from Nicaragua.

3. *Oedipina parvipes* (Peters) from Colombia. Also reported from Panamá.

4. *Oedipina complex* (Dunn) from Canal Zone.

From Costa Rica five species have been described, two of which are a part of the present collection. These are:

5. *Oedipina serpens* Taylor allied to *collaris*.

6. *Oedipina vermicularis* (Gray).

7. *Oedipina uniformis* Keferstein.

8. *Oedipina alfaroi* Dunn, perhaps allied to *elongata* (both are without maxillary teeth).

9. *Oedipina syndactyla* Taylor.

The collections from Costa Rica which are before me, contain 69 specimens of this genus, and they may be segregated as follows:

1. A large form from near Turrialba (2000 ft.) described as *Oedipina serpens* Taylor. One specimen.

2. A lowland form from the Pacific slope at San Isidro El General. One specimen.

3. A lowland form from Los Diamantes on the Caribbean slope. Fifty specimens.

4. A lowland form living with the preceding, having a slenderer body and smaller limbs. Five specimens.

5. A large form from near Turrialba 2000 ft. and Cervantes 4000+ ft. Five specimens.

6. An extremely-long-tailed species living with the preceding form at Cervantes. One specimen.

7. A form from approximately 6500 ft. elev. on Volcán Turrialba having a very unusual arrangement of the paravomerine teeth. One specimen.

8. A slender form with smooth elongate body; one specimen from Volcán Poás, described as *Oedipina syndactyla* Taylor.

9. Living with the preceding, a robust form generally resembling the Turrialba-Cervantes specimens but with the limbs greatly reduced. Five specimens.

Of the nine groups two have already been described (*serpens* and *syndactyla*); since none of the forms lack maxillary teeth none can be associated with *Oedipina alfaroi* Dunn.

There remain seven forms and two names, *Oedipina vermicularis* and *Oedipina uniformis*. Unfortunately both of these species are inadequately described so that the assignment of specimens to the names is not an easy task. The exact type localities of these named

species are unknown save that they are from "Costa Rica," and hence throw no light on the matter. The anatomical details given are few and may apply to more than a single form. On the basis of size both species exceed a snout-vent length of 50 millimeters. Since only three of the forms at hand seem to reach this size, it is most probable that only to these, if any, may the names be applicable. Two of these are forms occurring at Turrialba and Cer-vantes (Nos. 5 and 6 of the preceding list), and the third is the large form occurring on Volcán Poás (No. 9). Of these three, No. 5 would appear to agree most closely to *uniformis*, and to these I have assigned this name. I believe none of the forms are to be associated with *vermicularis*.

The following table of comparative measurements is given:

COMPARATIVE MEASUREMENTS OF OEDIPINA

	Uni- formis*	Vermi- cularis	Volcan Poas (No. 9)	Volcan Poas (No. 9)	Tur- rialba (No. 5)	Cer- vantes (No. 5)	Cer- vantes (No. 6)
Total length.	137	178	168	165 +	181 +	183	189.8
Snout to vent.	51	54	52	57	56	52	49.8
Snout to foreleg	11	.....	10.9	12	13	13.2	9.6
Axilla to groin	35	.....	35	38	37	34.5	35
Tail length.	86 +	124	116	108 +	125 +	131	140
Head length.	5	6	7.6	8	8.6	9	6.5
Head width.	4.5	3.5	4.2	5	5.4	5.3	4.3
Arm.	(5)?	4	4	4.7	6.2	6	3.5
Leg.	5	4.5	4.4	4.5	6.3	6.1	3.7
Head width in length.	11.33	15.43	12.43	11.14	10.37	9.81	11.6
Costal groove.	19	19	19.5	19.5	19	20	20

* Type measurements of *uniformis* and *vermicularis* as given, are arranged as nearly as possible to correspond to measurements here given for other forms. The tail is probably partly regenerated. In some cases the measurements represent close estimates.

A comparison of measurements shows certain differences between *Oedipina uniformis* and *Oedipina vermicularis*. The differences in measurements may or may not be significant since the technique of measurement of two workers may admittedly be different, but despite this possibility it would appear that the head is longer (20%) and narrower (22%) and the leg is shorter (10%) in a specimen that is nearly six percent longer from snout to vent. Moreover the tail in *O. vermicularis* is said to be "as thick as the body in its whole extent, rounded at the end." The type of *uniformis* has a head width of 4.5 mm., a body width of 4.5 mm. but the tail at its base is only 3 mm. The head width in snout-to-vent length in *uniformis* is 11.33 times; in *vermicularis*, 15.43 times. On the basis of these facts it would appear that there is insufficient evidence to warrant placing the forms in synonymy. The two types should both be examined and compared by a competent observer, and detailed

descriptions of the forms presented. Then and only then can there be certainty as to the proper usage of the two names.

Because of a closer approach of the large, central plateau form to the measurement of *uniformis* I am associating these specimens with that name. Other characters given in the type description (somewhat flattened head, cylindrical body, tail twice snout-vent length) all agree. The statement, "limbs light, almost without color" however does not agree completely. The limbs are distinctly lighter

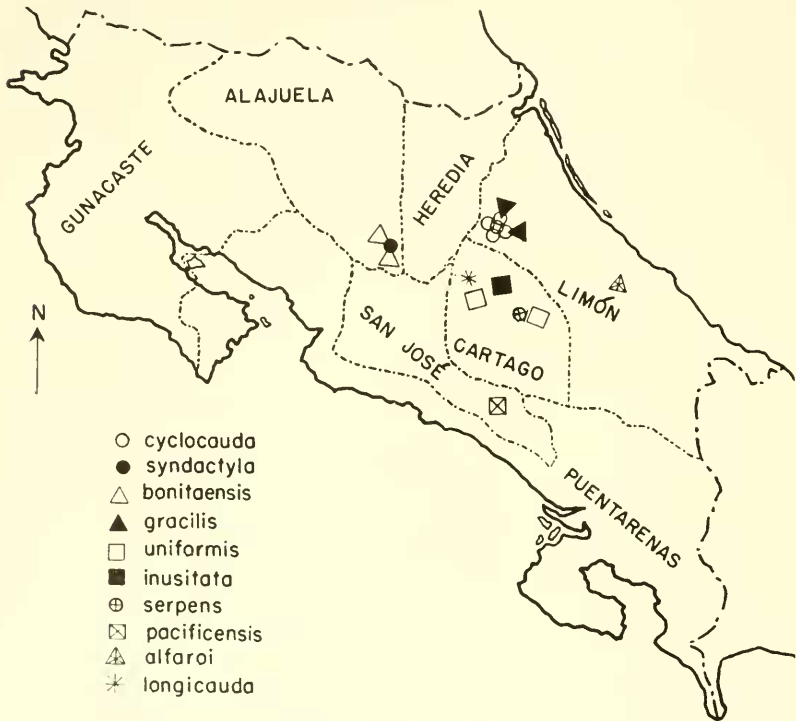


FIG. 5. Distribution of the species of *Oedipina* in Costa Rica.

than the body but do not approach the "without color" stage. That condition in the type might conceivably be due to fading. The apparent variation of the costal grooves may be due to method of counting the grooves.

The remaining forms are here treated as undescribed species. I am aware that this number of forms is large, and that larger collections may conceivably point to subspecific relations of certain of

those here named. The characters, where series are available, however, bespeak constancy.

A key has been devised as best showing the differential specific characteristics of the forms occurring in Costa Rica. It is applicable to the larger or largest adults known for each form.

KEY TO THE SPECIES OF THE GENUS OEDIPINA

1. Teeth absent in the maxilla; snout rather pointed; 20 costal grooves; one premaxillary tooth, not piercing lip, head width in length 12-14; folds between adpressed limbs 14-16; tail about twice snout-vent length. Panamá and southern Costa Rica *alfaroi* Dunn
 - Teeth present in maxilla; costal grooves 17-20 2
2. Smaller slender form under 65 mm. snout-to-vent length 4
 - Large form: 70 mm. or more snout-vent length 3
3. Snout sharp (*vide* Dunn); 11 costal folds between adpressed limbs; black with lighter dorsal markings; 19 costal grooves; head width 7.5 times in snout-vent length; dark preocular spot, a narrow postocular black streak; skin granular; tail 2.6 times body length. Nicaragua to ?Panamá. *collaris* (Stejneger)
 - Snout blunt, truncate, flattened; nearly uniform gray-slate; head width in snout-vent length 8.4 times; skin smooth; 9 costal folds between adpressed limbs; maxillary teeth 50-50. Eastern Costa Rica *serpens* Taylor
4. Costal grooves 17 5
 - Costal grooves 19-20 6
5. Digits terminate in rather sharp points; legs separated by 8 costal folds; head width in snout-vent length 9 times; snout sharp; eyes rather small; teeth on maxilla only to choanae; 25 maxillary teeth piercing gum; tail less than twice snout-vent length; brown above, light gray below. Colombia to Panamá, *parvipes* (Peters)
 - Digits not sharp pointed; legs separated by 9 costal folds; snout short and blunt; head width in snout-vent length 7.5 times; brownish black with brown flecks; leaden below; tail less than twice snout-vent length; "maxillary completely toothed"; eye equal to its length from snout tip. Canal Zone. . . *complex* (Dunn)
6. Paravomerine teeth in a single or double patch, more or less in a single plane 7
 - Paravomerine tooth-patches posteriorly strongly deflected downward; a small pit on occiput; head width in snout-vent length 10.7; 44.2 mm. snout-vent length; tail 87 mm. Volcán Turrialba *inusitata* Taylor
7. Head width in head-body length 15.4 times (Costa Rica) *vermicularis* (Gray)
 - Head width in head-body length less than 13 times 8
8. Arm and leg in snout-vent length approximately 10 or less times, 9
 - Arm and leg in snout-vent length 11 or more times 10

9. Greatest snout-vent length 46 mm. (50 specimens). Tail rarely reaching twice length of body, the average being approximately 1.9 times; maxillary teeth 16 to 20 on each side; 12.5 folds between limbs; snout rather pointed; tail nearly as wide body for much of its length, nearly cylindrical; arm in snout-vent length approximately 9 times; head width in same, 10.7 times; elevation approx. 1000 ft. northeastern Costa Rica *cyclocauda* Taylor
 Greatest known snout-vent length 61 mm.; tail 2.5 times head-body length; maxillary teeth 23 to 29; legs separated by 12 costal folds; snout rounded; tail tapering from base; elevation 2000-4000 ft.; arm in snout-vent length approximately 9 times; head width in same, 10 (-11) times. Central Plateau, Costa Rica *uniformis* Keferstein
10. Larger forms 50-57 mm. snout-vent length 11
 Smaller forms less than 50 mm. snout-vent length 13
11. Maxillary teeth reduced, 18 to 20; snout-vent length 49.8; tail much elongated, 2.8 times snout-vent length; 20 costal grooves; width of head in snout-vent length 11.6 times; arm in same, 14.2; 90 caudal grooves. Central Plateau, Costa Rica *longissima* Taylor
 Maxillary teeth increased, 24-29 12
12. Body proportionally longer, limbs slender; head width in snout-vent length 12.7 times; arm in same, 13.2 times; (tail?); maxillary teeth 27-29; mandibular teeth 33-36; south slope Volcán Poás, 7000 ft. *syndactyla* Taylor
 Body less slender, proportionally shorter; head width in snout-vent length (approx.) 12; arm in same, 13.4; maxillary teeth 24 to 28; mandibular teeth 31 to 35. South slope Volcán Poás, 6000 to 7000 ft., Costa Rica *bonitaensis* Taylor
13. Without white markings on head; 20 costal grooves, maxillary teeth total 37-45; length 41.5 mm. *gracilis* Taylor
 A pair of light markings on head; maxillary teeth total 26; length 42.5 mm. *pacificensis* Taylor

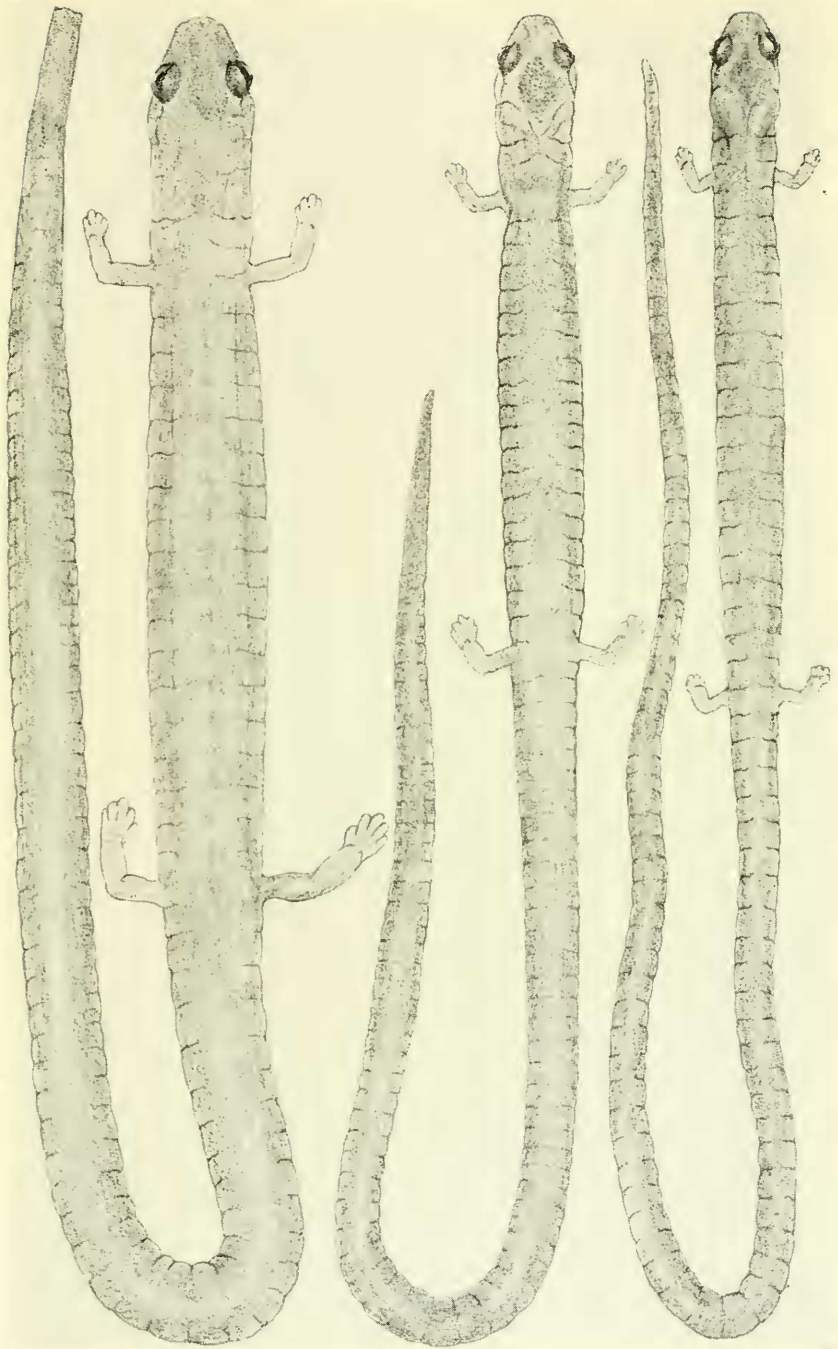
Oedipina serpens Taylor

Plate LXXXVI, fig. 1; text fig. 6

Oedipina serpens Taylor, Univ. Kansas Sci. Bull., vol. 33, pt. 1, Apr. 20, 1949, pp. 286-288 (type locality, Morehouse Finca, 5 mi. southwest Turrialba, Costa Rica, E. H. Taylor, coll. Erroneously stated "Morehead" Finca).

Diagnosis: A very large species of the genus; snout to end of vent, 74.5 mm.; tail more than twice head-body length; width of head in head-body length, 9.08 times; head length to gular fold

PLATE LXXXVI. Fig. 1. *Oedipina serpens* Taylor. Type, K.U.M.N.H. No. 23815, Morehouse Finca, 5 mi. SW Turrialba, Costa Rica. Total length of specimen 210.5 mm. Fig. 2. *Oedipina uniformis* Keferstein, K.U.M.N.H. No. 291, Cervantes, Costa Rica. Total length 183 mm. Fig. 3. *Oedipina bonitaensis* sp. nov. Type K.U.M.N.H. No. 647, 6 mi. by road, W of Isla Bonita, Volcán Poás, Costa Rica. Total length, 205 mm.



1

2

3

(median), 6.1 times; snout rather elongate, truncate not "sharp"; eye small; snout strongly overhanging lower jaw; digits grown together, free at tip, and rounded; 8-9 costal folds between adpressed limbs.

Description of the type: (K. U. M. N. H. No. 23815) Snout rather elongate, truncate, the dorsal surface curving without trace of canthus rostralis; median part of snout and interorbital region most elevated; eye very small, its diameter contained in snout length twice, or very slightly less; a small swelling below nostril on lip; posterior part of eyelids not tucked under a diagonal fold; nostrils very small, lunate in shape; width of upper eyelid in smallest interorbital distance, three times.

Gular fold strong, curving forward mesially; from sides of fold a nuchal groove runs up on side of neck but fails to meet its fellow on the mid-dorsal line; a distinct postorbital groove runs back from the eye directed slightly downward, then straight back to beginning of nuchal groove; a groove crosses chin in front of the gular fold, passes behind angle of mouth and reaches to dorsal surface of occiput; a short groove about midway between this and the nuchal groove laterally terminating at postorbital groove; only a faint suggestion of an arched groove on chin; no orbitolabial groove; no median dorsal groove; costal grooves nineteen, traceable to mid-ventral line, and to near middle of back; presumably a constriction at base of tail (tail severed); skin very smooth; limbs small, separated by nine costal folds when adpressed.

Arm adpressed reaches about two thirds distance to eye; fingers broad, grown together rather than "webbed", tips free with indistinct pads below; first finger without free tip, rather well developed; median finger rounded at tip; the other two fingers slightly narrowed at tip; toes very broad, grown together, the tips rounded, terminal joint free on all save inner, with small pads below tips; a white glandular spot behind leg insertion; walls of cloaca with very numerous papillae. Tail (severed and terminal portion missing) thick at base, tapering gradually; 52+ caudal grooves present.

Paravomerine teeth in two series narrowly separated mesially; vomerine teeth in two series, 15-16, which originate much outside outer level of choanae, run straight across mouth for greater part of their length, then curve back separated from each other by a distance equal to space between four teeth and separated from the paravomerine series by only a slightly greater distance. Choanae small, their length contained in distance between them about five times; three premaxillary teeth piercing gums; maxillary teeth about

50-50; mandibular teeth about 55-55; a strong free sublingual fold. Posterior extension of epibranchial reaches back to level of arm insertion.

Color: Dorsal and ventral color, grayish slate (under a lens the circular glands are whitish gray, the intervening space black); spots behind leg insertion bluish white; under surface of limbs somewhat brownish with some small whitish flecks; tip of snout with some indefinite lighter flecks; subnarial swellings and a minute line on



FIG. 6. *Oedipina serpens*. Type. Upper. Left hand, dorsal and ventral views. Lower. Left foot, dorsal and ventral views.

edge of upper lip cream; lower eyelid and part of edge of upper eyelid whitish; medial area on chin brownish with creamy flecks; hands and feet grayish on palms and soles.

Measurements in mm.: Snout to posterior end of vent, 74.5; snout to arm insertion, 20; axilla to groin, 47; arm, 10; leg, 13.2; head width, 8.8; head length to gular fold (medial), 12; head length to nuchal fold (lateral), 15; width of body, 9; width of tail base, 7; length of tail, 136 (missing part estimated at about 50 mm.).

Remarks: The specimen was found under a log in rather soft mud at the edge of a stream bank. It was especially active and elusive and escaped into a pile of large chips from which it was recaptured

with considerable effort. The tail was broken and part lost, perhaps by my stepping on chips under which it was moving. Search was made for the lost portion of the tail but it was not found.

Relationship: The relationship apparently is with *Oedipina collaris* Stejneger. The following table of contrasting characters shows the major differences between *collaris* and the one here described.

<i>Oedipina collaris</i>	<i>Oedipina serpeus</i>
1. Snout sharp.	1. Snout blunt, strongly truncate.
2. Head width in head body length, 7.5 times.	2. Head width in head-body length, 8.4 times.
3. Head length in head body length, 4.5 times.	3. Head length in head-body length, 4.9—6.2 times.*
4. Skin granular.	4. Skin smooth.
5. Vomerine teeth about nine.	5. Vomerine teeth fifteen.
6. Vomerine teeth extend straight across mouth.	6. Vomerine teeth straight for part of series then curving back.
7. Fingers and toes short, scarcely flattened.	7. Fingers and toes long, strongly flattened.
8. Paravomerine (parasphenoid) teeth separated from vomerine teeth by half length of latter series.	8. Paravomerine teeth separated from vomerine teeth by one third length of one of latter series.
9. Eleven costal folds between adpressed limbs.	9. Nine costal folds between adpressed limbs.
10. Last joint of the third and fourth toes free of membrane.	10. Last joints of second, third and fourth free of membrane.
11. Large dark preocular spot and a narrow black postocular streak.	11. These markings not present.

Oedipina uniformis Keferstein †

Plate LXXXVI, fig. 2; text fig. 7

- Oedipina uniformis* Keferstein, Nachricht. Ges. Wiss. Göttingen, 1868, p. 331 (type locality, Costa Rica; von Seebach, coll.); Archiv. für Naturg., Jahrg. 34, vol. 1, 1868, p. 299, pl. 9, figs. 8, 9; Günther, Zool. Record for 1868, (Gives Aug. 1868 as the date of publication of Keferstein's *Oedipina uniformis* and Oct. 1868 for Gray's *Ophiobatrachus vermicularis* which Günther says is "evidently the same animal"); Dunn, Bull. Mus. Comp. Zool., vol. 62, 1918, p. 471; ?Noble, Bull. Amer. Mus. Nat. Hist., vol. 44, 1921, p. 2 (skull); Taylor, Univ. Kansas Sci. Bull., vol. 33, pt. 1, May 15, 1944, pp. 226-227.
- Spelerpes uniformis* Strach, Mem. Acad. Sci., St. Petersbourg, ser. 7, vol. 16, pt. 4, p. 84; Boulenger, Catalogue of the Batrachia Gradientia s. Caudata and Batrachia Apoda in the collection of the British Museum, Ed. 2, 1882, p. 75 (*part.*) (only type of *vermicularis* mentioned from Costa Rica); Günther, Biologia Centrali-Americana, Jan. 1902, p. 304 (Costa Rican localities: La Palma, alt. 1600 m., Biolly coll.; Bebedero and Irazú, Underwood coll.).
- Oedipus uniformis* Dunn, Zool. Ser. Field Mus. Nat. Hist., vol. 12, 1924, p. 99; The Salamanders of the Family Plethodontidae, Smith College Publ., 1926, pp. 427-430 (*part.*).

* The gular folds curves strongly forward on middle of throat; head measured to this point, its length is 12 mm., to the side of head the measurement is 15 mm.

† Certain of these references may actually apply to other forms.

Description of species: K.U.M.N.H. No. 29975 ♂, Cervantes, Costa Rica, elevation somewhat above 4000 ft., July 9, 1947, E. H. Taylor and R. C. Taylor colls.). Head a somewhat truncate oval; eyes small, the length of eye opening (1.85 mm.) slightly smaller than snout length (1.9 mm.); top of head flattened to base of snout, then curving down slightly to nostrils which are nearly terminal; groove from nostril running back and down, the subnarial swelling distinctly behind the posterior level of nostril; groove following inner edge of upper eyelids continued behind eye, as the postorbital groove, to the lateral nuchal groove, the groove curving down strongly, forming an angle; a somewhat sinuous groove begins on side of occiput, bisects the postorbital groove, continues down across the chin to opposite side; on middle part of chin it curves back slightly and a pair of grooves run forward on chin completing an arch; a small groove from angle of mouth runs back and bisects the groove on side of head. A prominent gular groove and fold curves forward on neck; from its side a lateral nuchal groove curves forward and upward but fails distinctly to meet its fellow from opposite side.

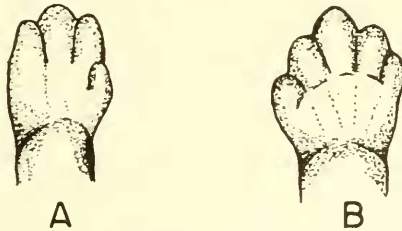


FIG. 7. *Oedipina uniformis*. A. Left hand, dorsal view, B. Right foot, dorsal view. (Much enlarged.)

Tongue free with a distinct sublingual fold; 24-26 maxillary teeth; two premaxillary teeth; mandibular teeth 25-27; choana rather large followed by a postchoanal groove that is nearly the width of choana; vomerine teeth in two strongly elevated rows beginning beyond outer level of choanae, curving in and back, 10 teeth in each series, separated mesially by a distance approximately equal to a diastema between two teeth; palate in front of vomerine ridges rather shallow with a median shallow pit; behind ridges there are deep excavations leaving the elevation of the ridges .85 mm. high; paravomerine teeth in a single group, pointed anteriorly, widened posteriorly and rounded behind; a mesial area near middle of patch

without teeth; total number of paravomerine teeth approximately 127.

Costal grooves 20 (the posterior costal fold partly divided, the groove not reaching lower level of other grooves); 80 or 81 caudal grooves present behind vent, the tail not certainly constricted at base; no dorsal longitudinal median groove on body or tail, no groove on underside of tail; arm short, hand slender, palmate, four fingers present, grown together with the tips of the second and third free, rather pointed; outer fingers completely involved; leg short, slender, the foot palmate, the limbs when adpressed separated by the equivalent of 12 costal folds.

Color: Dorsal and ventral color above deep bluish slate; the head (submerged) is brownish; the limbs lighter brownish-flesh with a fine darker reticulum; palm and sole lacking pigment; gray-white postiliac spot and an indistinct light area about insertion of arm and leg; outer edge of chin lighter than central part which in turn is a little lighter than venter; an area on top of head in which the individual skin glands are more distinct than elsewhere; subnarial swelling and medial area of upper lip light.

Measurements in mm.: The measurements of this specimen are included in the table of measurements for this species.

TABLE OF MEASUREMENTS AND DATA ON OEDIPINA UNIFORMIS

MUSEUM	RCT	KUMNH	RCT	RCT	KUMNH
Number.....	1021-A	29975	290	222	29976
Sex.....	♂	♂	♀	♂	♂
Locality.....	Cervantes	Cervantes	Cervantes	Turri-alba	Turri-alba
Snout to vent (body length.).....	56	52	50.4	54	44
Snout to foreleg.....	13	13.2	12	12	10.5
Axilla to groin.....	37	34.5	32.5	35	28.6
Length to gular fold (head length).....	8.6	9	8	8	7.4
Width of head.....	5.4	5.3	5.5	5.3	4.5
Tail length.....	125+	131	89+	110+	61+
Arm.....	6.2	6	5.8	6.15	5
Leg.....	6.3	1	6.1	6	5.5
Head width in body.....	10.37	9.8	9.1	10.1	9.8
Head length in body.....	6.51	5.8	6.3	6.75	5.9
Costal grooves.....	19	20	19	19	20
Costal folds.....	18	19	18	18	19
Caudal folds.....	68+	80	55+	?	50
Maxillary teeth.....	24-26	23-26	25-26	29-26	20-19
Mandibular teeth.....	25-27	26-28	34-36	23-25	33-33
Premaxillary teeth.....	4	2	5	3	3
Vomerine teeth.....	10-12	8-8	11-11	10-10	6-6
Paravomerine teeth.....	127	140	140	?	?

Variation: The head of this form is definitely brownish and there is in some of the specimens a suggestion of brown on the dorsal surface; this is due to the color of the skin-glands which under a lens

may be seen as minute rounded areas surrounded by a blackish reticulum. The brown on the head is more definite in a younger specimen (R.C.T. No. 290); the underside of the hind limbs in R.C.T. No. 1021-A is lighter than in other specimens. The anal slit in all the specimens, except No. 29975, is light. In all, there is a sharply-defined white line in the gular groove, but hidden by the gular fold.

Males have the cloacal walls very finely papillate, but in the females indistinct folds are present. Males have the submental hedonic gland very irregularly shaped, not prominent.

The tails of Nos. 29975, 222 and 29976 are complete; that of R.C.T. No. 222 has the terminal part regenerating. The tip is missing in 102-A, a part estimated at 12 mm.

Oedipina vermicularis (Gray)

Ophiobatrachus vermicularis Gray, Ann. Mag. Nat. Hist., ser. 4, vol. 2, 1868 (Oct.), p. 298 (type locality, Costa Rica).

Ophicobatrachus vermicularis Cope, Proc. Acad. Nat. Sci. Philadelphia, 1869, p. 102 (At this time Cope believed Gray's name had been published before Kesterstein's, and placed *Oedipina uniformis* in synonymy.); Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1875, p. 96 (*part.*?) (very probably two species are represented in the lot. He reports one specimen from Pico Blanco 6000 ft., and two from eastern lowland Costa Rica).

Spelerpes vermicularis Smith, The Tailed Amphibia, 1877, p. 94; ?Brocchi, Étude sur les Batraciens; Mission Scientifique au Mexique et dans l'Amérique Centrale, livr. 3, 1883, p. 118, pl. 20, fig. 1, (*part.*) (Costa Rica and Guatemala). The figure given is of a specimen from Guatemala and most probably belongs to another species.

Spelerpes uniformis Boulenger (*part.*), Catalogue of the Batrachia Gradientia s. Caudata, and Batrachia Apoda in the Collection of the British Museum, 2nd ed., 1882, p. 75 (gives measurements of the type of *vermicularis*).

Description of species: The original description offers but little information on this form. The differences in measurements from those of *uniformis* (as given by Boulenger, *loc cit.*) give evidence that it is not a synonym of *uniformis*. Thus the length of the leg in snout-to-vent length in *uniformis* is approximately 10 times; in *vermicularis* approximately 12 times; the head width of *uniformis* in snout-to-vent length is approximately 11.1 times; in *vermicularis* 15.4 times; the head length of the two forms in snout-to-vent length is respectively 10.4 and 9 times. It will thus be seen that *vermicularis* has a long body, and a very narrow elongate head.

The data available on the type as given by Boulenger, *loc. cit.*, is as follows:

"Parasphenoid [= paravomerine] teeth in a single patch. Habit

more worm-like still [than *Spelerpes lincolus*]. Tail as thick as the body in its whole extent, rounded at end. Nineteen costal grooves."

Total length	178	mm.
Snout to vent	54	mm.
Head [length]	6	mm.
Width of head	3½	mm.
Fore limb	4	mm.
Hind limb	4½	mm.
Tail	124	mm.

The above measurements obviously are those of the type. With the publication of a careful, detailed description of this species, together with accurate measurements, it may be possible to refer to it one of the forms here described as new.

Oedipina bonitaensis sp. nov.

Plate LXXXVI, fig. 3; text fig. 8

Type: Kansas University Museum of Natural History No. 29972 ♀ collected approximately 6 mi. (by road) west of Isla Bonita (American Cinchona Plantation), southern slope of Volcán Poás, Costa Rica; Aug. 3, 1947. R. C. Taylor and E. H. Taylor colls.

Paratypes: R.C.T. Nos. 645, 646, 649; K.U.M.N.H. Nos. 29973, 29974; same locality data, and collectors.

Diagnosis: A medium-large *Oedipina*, the largest known snout-to-end of vent measurement, 57 mm.; width of head in snout-vent length, 11.2 times; adpressed limbs separated by 14 costal folds; length of eye greater than axial snout length; tail length 2.7 times snout-to-vent length; maxillary teeth 24-28; palatal area, in front of vomerine ridges, on a level with palate behind them.

Description of type (♀): Head as wide or slightly wider than body; the length of the eye (1.8 mm.) greater than axial length of the snout (1.45 mm.); snout extending beyond lip .7 mm.; groove from small nostril runs diagonally to the subnarial swelling which is behind, but reaching posterior level of the nostril; posterior part of eyelids terminate in a short groove; occipital and interorbital region flat, the top of the snout very slightly elevated and in profile rounding forward to lip; no canthus; groove bordering inner edge of supraorbital part of eyelid scarcely indicated; a vertical groove begins near top level of occiput, runs down across jaws curving backward as it crosses chin; on each side from outer ends of the curved part two distinct grooves run forward on chin but fail to meet by a considerable distance; gular fold strong, curving forward on throat, and from its ends, a nuchal groove arises, curves back a little,

then upwards and forward, meeting its fellow on the mid-dorsal line; elevation caused by the epibranchial cartilage can be traced but little beyond hind level of arm insertion, postorbital groove from orbit runs diagonally back until it bisects the vertical groove then continues back horizontally to end of gular fold.

Maxillary teeth 26-26, running back to posterior level of eye; one or two premaxillary teeth piercing the gum; vomerine teeth beginning beyond outer level of the choanae, but failing to meet mesially by a diastema half diameter of a choanae, separated from paravomerine teeth by a distance more than twice diameter of a choana; paravomerine tooth series forming a patch more or less completely divided mesially by a distinct line without teeth, the teeth totaling approximately 185; mandibular teeth approximately 35-35; a distinct sublingual fold present.

Arm short, small, when adpressed covering two and one-fourth costal folds; outer fingers completely involved in the palm; second

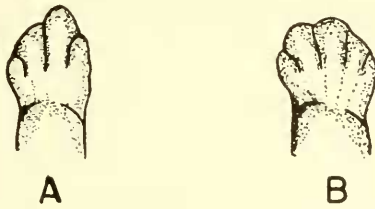


FIG. 8. *Oedipina bonitaensis*. Type.
A. Right hand, dorsal view. B. Right foot, dorsal view. (Much enlarged.)

with tip, third with about one and a half phalanges free, the two digits closely approximated but with a slight emargination between; outer toes involved in the sole, three inner digits with the tips free, the digits closely grown together save for a slight emargination (the right foot is abnormal, having only four digits); 20 costal grooves, counting one in the groin. The large costal fold in front of the hind leg is only partially divided, the number of costal folds is properly $18\frac{1}{2}$ since a part of the 19th is actually above the hind limb; 85 caudal folds, the tail subcylindrical and tapering, with a growing tip; a glandular area behind leg insertion; cloacal walls papillate; skin generally smooth although pits are visible under magnification.

Color: Body and head brownish, the sides gray or slaty brown; the ventral surfaces from gular fold to vent lighter than dorsum; chin and throat much lighter than venter; tail slate or bluish slate,

not or but scarcely lighter below; a white spot covers the postiliac gland behind leg insertion; limbs on dorsal parts nearly as dark as dorsum; undersides lighter with some small whitish marks; chin with some indefinite whitish areas or reticulations; edge of upper eyelids dull cream.

Measurements: (See table).

Remarks: There are two young specimens taken at the same time that are not included in the table of data. They agree in such characters as their size and age would permit. Thus the tooth totals are smaller and the caudal folds fewer. All six specimens were taken from five to six miles west, by road, from Isla Bonita.

This species was found under logs. One other species, *Oedipina syndactyla* was taken in the general vicinity. This latter differs in having a smoother body surface; the grooves less distinct, proportionally greater snout-to-vent length in proportion to head width, much more slender body, more pointed snout, longer narrower digits, etc. These two forms should not be mistaken.

MEASUREMENTS AND DATA ON *OEDIPINA BONITAENSIS* SP. NOV.

MUSEUM	KUMNH	RCT	KUMNH	RCT
Number.....	29973	646	29974	645
Sex.....	♂	♀	♂	♂
Snout-to-vent (body length).....	57	57	56	52
Snout to foreleg.....	12	11.4	11.6	10.9
Axilla to groin.....	38	39	37.9	35
Length to gular fold (head length).....	8	8	8	7.6
Snout to lateral nuchal groove.....	9.1	9	9.1	9
Width of head.....	5	4.7	4.9	4.2
Tail length.....	108 -	136 -	149	116
Arm.....	4.7	4.3	4.2	4
Leg.....	4.5	4.5	4.6	4.4
Head width in body length.....	11.14	12.1	11.4	12.2
Head length in body length.....	7.1	7.1	7	6.8
Costal grooves.....	20	20	20	20
Costal folds.....	18½	18½	18½	18½
Caudal.....	54 +	91	85 +	78 +
Maxillary teeth.....	28-27	25-24	26-26	26-25
Mandibular teeth.....	32-32	35-35	32-31	31-31
Vomerine teeth.....	9-9	12-12	11-10	10-9
Paravomerine teeth.....	180			

Oedipina cyclocauda sp. nov.

Plate LXXXVII, fig. 4; text fig. 9

Type: Kansas University Museum of Natural History No. 25066, collected at Los Diamantes (1 mile south of Gúapiles), Costa Rica, September 1-8, 1947, by Richard C. Taylor and Edward H. Taylor.

Paratypes: K. U. M. N. H. Nos. 25038-25065; RCT field Nos. 3137-3176, same locality data, and collectors.

Diagnosis: A small species of the genus, maximum known length from snout to end of vent, 46 mm.; tail 1.9 to approximately 2

times head-body length; head not distinctly wider than body; tail nearly half its length maintaining a width closely approaching that of body; adpressed limbs of large adults separated by approximately 12.5 costal folds; head width in snout-vent length, approximately 11 times; tongue rather far forward, with a distinct sublingual fold; maxillary teeth 16 to 20 on each side; anterior part of palate not elevated more than that part posterior to vomerine teeth; vomerine tooth series straight across palate to near median line where they turn back suddenly; paravomerine teeth all on same level; 19 costal grooves; snout narrowed toward tip.

Description of the type: Body and tail for the most part cylindrical, the tail for much of its length very little narrower than body; snout somewhat pointed, rather than blunt; the eyes small; the length of eye (edge of upper eyelid) equal to or slightly less than length of snout; width of an upper eyelid 1.8 times in interorbital distance. Nostril small, the groove running down and only slightly backwards to the subnarial swelling whose anterior edge is below edge of nostril; groove from eyelid running diagonally back and down from eye, then straight back to nuchal groove, bisecting a groove beginning at upper surface of head and running across jaw and throat, becoming somewhat concave mesially on chin; from this, two narrow, slightly-converging grooves run forward on chin; nuchal fold not strong, curving slightly forward on throat, the nuchal groove passing up on sides of neck but failing to reach middorsal line; top of head smooth, somewhat rounded across occiput without any area of glandular pits evident; in lateral profile snout tip is farther forward than lip; tongue rather far forward with a sublingual fold; maxillary teeth 19-20, bearing brownish tips; premaxillary teeth (♂), two, piercing the inner edge of lip, not visible externally; vomerine teeth 9-10 on two elevated ridges, nearly transverse save that the inner ends of the two series curve back; paravomerine teeth approximately 180, all on same plane, in a single patch, not, or but indefinitely notched behind, separated from the vomerine teeth by a space less than half length of one vomerine series; width of patch, twice in its length. Four fingers on hand, inner small (abnormally rudimentary on right hand), third longest, its tip free as is that of second; five toes, all somewhat pointed at tips; third longest, second and fourth subequal, tips of all three free for nearly a third of their length; tip of fourth minutely free; adpressed limbs separated by 12.3 costal folds. Costal grooves 19, last one indicated a short distance in front of groin; a well-defined postiliac gland; cloaca lined anteriorly with

papilla in male (folds in female). Skin smooth throughout body and tail; under a lens, skin glands usually not visible on head, dorsum, or on upper part of sides; skin glands visible low on sides, less so on chin, venter and on lateral and ventral surfaces of tail; caudal grooves 68, more or less clearly marked.

Measurements in mm.: Snout to end of vent 44.6; snout to arm insertion 10; axilla to groin 28.8; tail 95, width of head 4.1; width of body 4.2; width of tail at base 4; length of head (to middle of nuchal fold) 7; head to nuchal groove (lateral) 7.9; arm length 4.9; leg length 5.2; hand width 1; foot width 1.3.

Color: Dorsally and laterally on head, body, and tail, grayish slate, becoming slightly brownish on latter half of tail; chin dirty gray-brown with some lighter areas; nuchal fold cream; arms and legs lighter below than on dorsal surfaces; a cream cloacal spot.

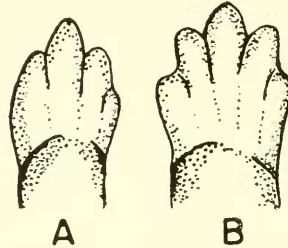


FIG. 9. *Oedipina cyclocauda*. Type. A. left hand, dorsal view. B. Right foot, dorsal view. (Much enlarged.)

and a whitish spot covering postfemoral gland; narrow, indistinct lighter areas bordering insertion of limbs.

Variation: The accompanying table for the most part shows a relatively small amount of significant variation. The counts of the paravomerine and other teeth are close approximations, usually counting spaces where teeth are missing.

A young specimen (35 mm. snout-to-vent) has the following dental counts: maxillary 15-16; vomerine 10-8; mandibular 25-25; approximately 160 paravomerine teeth. Thus the normal number of teeth are acquired early in life; however the aggregate is a little larger in old adults.

The glands of the skin on dorsal and lateral regions are visible in many specimens, although they are not visible on all parts of the type. The number of caudal folds of grooves varied, in the measured series, from about 56 to 70; in these the distinctness of the

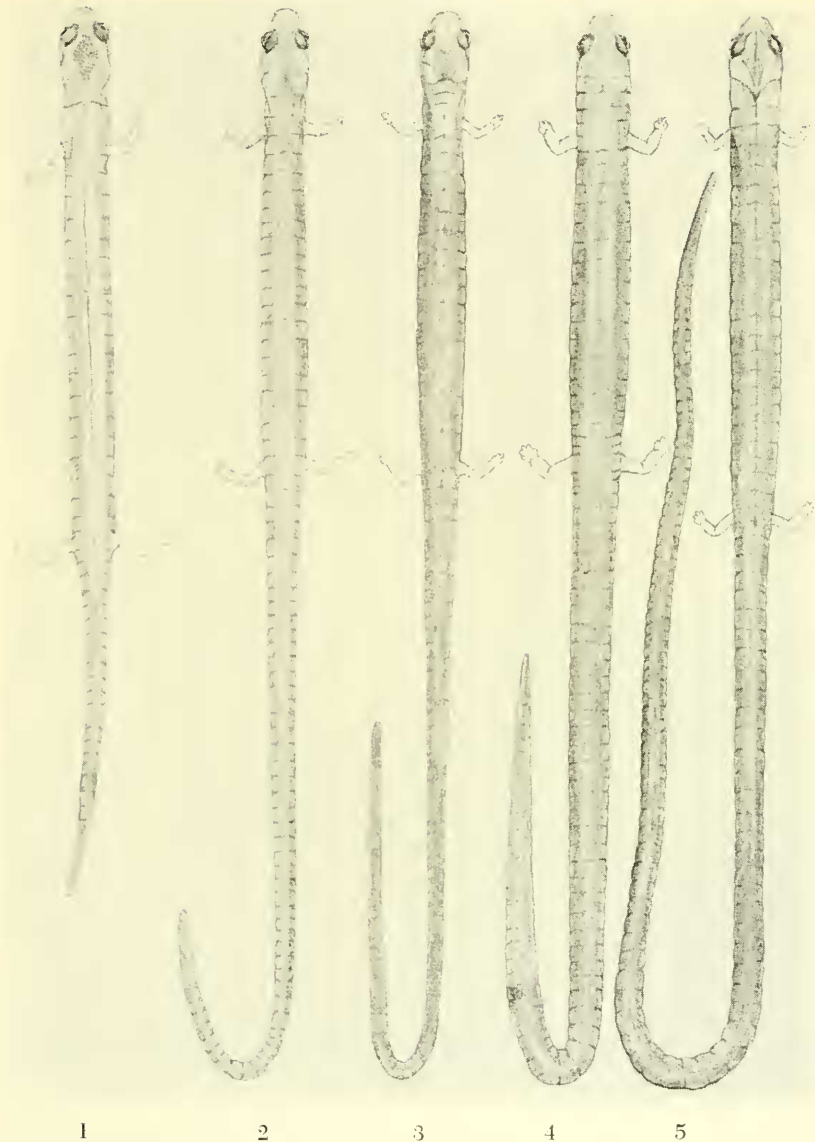


PLATE LXXXVII. Fig. 1. *Oedipina syndactyla* Taylor. Type, K.U.M.N.H. No. 29962, 4 mi. W by road from Isla Bonita, Volcán Poás, Costa Rica. Snout to vent length, 54.8 mm. Fig. 2. *Oedipina pacificensis* sp. nov. Type, K.U.M.N.H. No. 29965, 2 mi. E San Isidro El General. Total length, 119.5 mm. Fig. 3. *Oedipina inusitata* sp. nov. Type, K.U.M.N.H. No. 29964, 3 mi. NE Santa Cruz, Volcán Turrialba. Total length, 133 mm. Fig. 4. *Oedipina cyclocauda* sp. nov. Type, K.U.M.N.H. No. 25066, Los Diamantes, 1 mile S Guápiles, Costa Rica. Total length, 139.6 mm. Fig. 5. *Oedipina longissima* sp. nov. Type, K.U.M.N.H. No. 29963, Cervantes, Costa Rica. Total length, 188.9 mm.

vertebral differentiation of the tip of the tail varied. In some, the grooves were not indicated and the number of vertebrae were not estimated in these. The tail length reaches to 2.2 times snout-vent length (in No. 3158 ♂), but in most cases the tail is about twice the head-body length. The tail in the younger specimens is usually a little narrower in relation to the width of the body than in the type.

Remarks: These specimens were taken largely from rotting logs in which beetle larvae had burrowed. The salamanders seemed to follow the tunnels made by the departed larvae. Another species, *Oedipina gracilis*, occurred in the same logs. Other specimens were found in piles of rotting weeds or about stumps. They moved rapidly and often escaped after being exposed by chopping the logs to pieces. Numerous specimens were destroyed in the chopping process.

The name given is in reference to the circular caudal grooves.

Oedipina syndactyla Taylor

Plate LXXXVII, fig. 1; text fig. 10

Oedipina syndactyla Taylor, Proc. Biol. Soc. Washington, vol. 61, Nov. 12, 1948, pp. 179-180 (type locality, 7000 ft. elev., 4 mi. W by road from Isla Bonita [American Cinchona Plantation], Volcán Poás, Costa Rica, Aug. 5, 1947. E. H. Taylor coll.).

Diagnosis: Snout bluntly pointed; body slender slightly angulate rather than cylindrical; eye large, longer than snout, equal to its distance from tip; 20 costal grooves; adpressed limbs separated by 14-15 costal folds; digits fused together rather than webbed, the digits elongate; the extreme tips of 2 fingers on hands, and 3 toes on feet, free; 27-29 maxillary teeth; 4 premaxillary teeth; 10-11 vomerine teeth; paravomerine teeth in two distinct elongate patches closely approximated; the toes relatively longer than in other *Oedipina*.

Description, from type: (K.U.M.N.H. No. 29962, field No. 843). Head moderately elongate, narrow, rather bluntly pointed, its width in snout-to-vent length 12.7 times; nostrils distinctly back from snout tip; eye large, its length greater than snout length, equal to its distance from tip; distance between nostrils equal to their distance from eye; eyelids approximately as wide as interorbital distance, not tucked under a fold posteriorly; a strong, curved, gular fold, from the sides of which emerges a nuchal groove that curves up on sides of head to dorsal surface; a vertical groove between eye and nuchal groove that crosses chin; a pair of grooves run forward from this but fail to form a complete arch on chin; a very dim groove

TABLE OF MEASUREMENTS (IN MM.), AND DATA FROM PARATYPE SERIES OF OEDIPINA CYCLOCAUDA

MUSEUM	RCT	KUMNH	RCT	RCT	RCT	RCT	RCT	RCT	RCT	RCT
Number.....	3145	25066	3162	3147	3138	3152	3140	3154	3158	
Sex.....	♂	♂	♀	♀	♀	♂	♀	♂	♂	
Snout to end of vent.....	46	44.6	44	43	42.6	42.6	41.6	41.2	41	
Snout to foreleg.....	9.8	10	9.4	9	9.2	9.5	8.7	9	8.9	
Snout to nuchal groove.....	8	7.9	8.1	7.8	7.7	7.3	7.2	7.6	7.9	
Snout to nuchal fold.....	7	7	7	7	7	6.7	6.8	7	7	
Axilla to groin.....	30.6	28.8	29	28	28.5	27.2	27	27.2	26.8	
Head width.....	4.3	4.1	4.6	4.15	4.3	4.3	4	4	4.2	
Tail length.....	32	9.5	7.4	69+	.....	76	75	76	90.3
Head length to nuchal fold.....	7	7	7	7	.....	6.7	6.8	7	7
Arm.....	4.6	4.9	4.3	5	4.2	4.3	4.3	4.4	4.4	
Leg.....	5.2	5.2	5.2	5.2	4.95	5	5.2	5	5.2	
Costal grooves.....	19	19	19	19	19	19	19	19	19	
Costal folds.....	18	18	18	18	18	18	18	18	18	
Maxillary teeth.....	16-18	19-20	0-18	18-18	16-18	14-15	19-19	18-20	15-16	
Mandibular teeth.....	23-24	25-25	28-28	27-27	26-26	26-25	27-27	26-28	23-23	
Vomerine teeth.....	10-10	9-10	10-11	10-9	9-9	7-7	8-9	9-11	8-7	
Paravomerine teeth.....	152	180	174	160	156	172	170	172	150	
Premaxillary.....	4	1	4	4	4	3	4	2	3	

from eye to the lateral nuchal groove; no groove on the inner border of upper eyelid.

A well-defined sublingual fold; 27-29 maxillary teeth (counting missing teeth), reaching slightly farther back than middle of eye; vomerine teeth 11-10, on ridges beginning outside level of choanae passing mesially for a distance, then turning back toward mesial line but narrowly separated mesially; 4 premaxillary teeth in the line of maxillary tooth row; 33-36 mandibular teeth; tongue free; paravomerine teeth in two elongate patches more or less contiguous anteriorly, separated from vomerine teeth by twice diameter of choana, the teeth numbering approximately 161 (new teeth are added on the outer edges; sometimes an elevation is present but the tooth had not erupted).

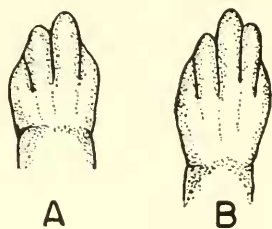


FIG. 10. *Oedipina syndactyla*. Type. A. Right hand, dorsal view. B. Left foot, dorsal view. (Much enlarged.)

Arms short, when extended along body their length equal to about $2\frac{1}{2}$ folds; legs about same size; hands and feet small; digits rather elongate, narrow, grown together without emargination, tips of two middle fingers and three middle toes equally free, bluntly pointed; outer digits small, completely fused with adjoining digit and incorporated in foot or palm.

Skin very smooth, even under a lens the openings of the glands not or scarcely discernible (except for a specialized somewhat depressed diamond-shaped occipital area reaching to between eyes in which pits and the glands are especially distinct); 20 costal grooves or lines, indistinct, the costal folds not elevated; tail presumably with a basal constriction (tail severed immediately behind vent, the broken part short, partially regenerated); cloacal walls smooth with indications of lateral folds (female); a postiliac gland; a small elongate ridge preceding vent to between legs.

Color: Slate-gray above, gray below; edge of gular fold cream; chin much lighter than venter; a cream spot below insertion of arms

and legs; undersurface of upper arm and leg with cream markings; lower eyelid somewhat cream, and a lighter line following the nasolabial groove from nostril to lip. A light area about vent.

Measurements in mm.: Snout to end of vent, 54.8; tail short, with terminal regenerating portion broken off immediately behind vent; width of head, 4.3; length to median part of gular fold, 7.5; axilla to groin, 38; snout to arm insertion, 10.6; head width in snout-to-vent length, 12.7 times; head length in same, 7.3 times.

Remarks: The unique specimen was captured in more or less open pasture land at an elevation of about 7000 feet on Volcán Poás.

Another species, *Oedipina bonitaensis*, was found in the same general area about one to two miles farther west at about the same elevation, 6000-7000 feet. This form is larger, with a proportionally thicker head and body, the skin less shiny smooth, with proportionally thicker, shorter digits. The costal grooves are definitely grooves rather than lines; the snout is more rounded at the tip. Since the tail is incomplete in *syndactyla*, this character cannot be compared.

Oedipina longissima sp. nov.

Plate LXXXVII, fig. 5; text fig. 11

Type: Kansas University Museum of Natural History No. 29963 ♀, collected at Cervantes, Costa Rica, July 9, 1947, by Edward H. Taylor and Richard C. Taylor.

Diagnosis: A species of medium size, the snout-vent measurement 49.8 mm.; the tail 140 mm., two and eight-tenths times the snout-vent length; eye a little longer than snout; 20 costal grooves; caudal grooves 90; width of head (4.3 mm.) in snout-vent length, 11.6 times; head length (6.5 mm.) in same, 7.6 times; skull well ossified; no special pit or depression behind occiput; paravomerine teeth all on same level; maxillary teeth 20-18; adpressed limbs separated by about 14.5 costal folds; tongue far forward in mouth with a very well-developed sublingual fold; choanae small; tail subcircular, slightly compressed toward tip.

Description of type: A slender, elongated species, the tail 2.8 times the length from snout to end of vent; the head width (4.3 mm.) in snout-vent length (49.8 mm.), 11.6 times; head length (6.5 mm. from tip of snout to middle of nuchal fold) in same, 7.6 times; head rather flattened, rounding above, the eye small, the length of eye (free edge of lid) slightly longer than snout; snout moderately blunt, slightly emarginate medially seen from above; groove from nostril runs backward and downward; little or

no subnarial swelling; loreal region inflated so the surface across snout from lip to lip is a continuous curve; no groove marks the inner edge of eyelid; a strong groove from eye back to the nuchal fold, in nearly a straight line, bisecting a vertical groove that begins near top of head and crosses jaw to side of chin where it terminates; from near the ventral ends two fine grooves converging somewhat, run forward to near tip of chin. The nuchal groove with an ample fold, curving forward across the throat; on the sides the groove can be traced to near the median dorsal line; posterior extension of epibranchial forms fold that reaches to the second costal fold; width of an eyelid in interorbital width approximately two times. Tongue very far forward, with a strongly-developed sublingual fold; maxillary teeth 20-18; premaxillary teeth 4; vomerine teeth 8-10, in a very irregular row on two elevated ridges begin-

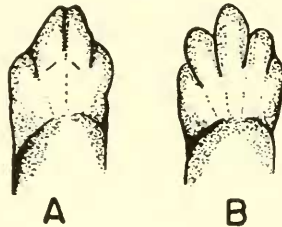


FIG. 11. *Oedipina longissima*. Type. A. Right hand, dorsal view. B. Right foot, dorsal view. (Much enlarged.)

ning outside of level of choanae and curving in and back, nearly meeting medially; paravomerine teeth approximately 150, in a large single patch all on the same level, rather narrowly separated from vomerine series; the patch is slightly notched behind, its greatest width in its greatest length 2.4 times; mandibular teeth 18-18; choanae small, the diameter of one in distance between them nearly four times; arm small, slender, width of hand .6 mm.; adpressed limbs separated by 14.5 costal folds; four fingers, the tips of three outer free; third longest, and bluntly pointed rather than rounded; leg (3.7 mm.) minutely longer than arm (3.5 mm.); five toes, the three inner largest, and free for nearly half their length, rounding at tips; first and fifth toes reduced, tips not free. A slightly elevated pitted area on the top of head extending forward between eyes; remainder of head smooth; body smooth or relatively so; tail without a basal constriction, subcircular in cross-section save

toward tip where it is slightly compressed laterally; caudal grooves 90 +; a rather large postiliac gland; under a lens glands visible over the body appearing as rounded cream spots in a brownish reticulum.

Measurements in mm.: Snout to vent 48.9; tail 140; snout to foreleg 9.6; snout to nuchal groove (lateral) 7.8; axilla to groin, 35; length of head 6.5; width of head 4.3; arm 3.5; leg 3.7.

Color: Head somewhat brownish, most distinctly brown over the dorsal pitted area; dorsal and lateral surface brownish with a suggestion of a grayish film; sides a little darker, dorsum and sides of tail bluish slate. Chin lighter than venter with a few lighter flecks scattered along sides of venter; underside of tail somewhat brownish, but lacking cream flecks.

Remarks: It is probable that this species has a larger number of caudal vertebrae (90 +) in old adults than any other plethodontid. The number increases throughout life or at least during the early years.

The most important distinguishing characters are: great tail length, the forward position of the tongue, and the discontinuity of the groove across chin.

The specimen was dislodged from loose soil under a rock.

Oedipina gracilis sp. nov.

Type: Kansas University Museum of Natural History No. 29969 ♂, collected at Los Diamantes, one mile south of Guápiles, Costa Rica, Sept. 8, 1947, by Richard C. Taylor and Edward H. Taylor.

Paratypes: K. U. M. N. H. Nos. 29968, 29970; R. C. T. Nos. 1420, 1419, topotypes, same collectors.

Diagnosis: A small species with much reduced limbs and an elongate tail; 19 costal folds, 20 costal grooves distinct; 86 caudal folds; body somewhat flattened, the tail cylindrical, tapering; eye large, longer than snout; maxillary teeth 18-19; vomerine teeth 7-7; the ridges not especially high; 2 premaxillary teeth piercing gum, limbs separated by 14 costal folds.

Description of the type: Snout-to-end-of-vent length, 41 mm.; width of head (4 mm.) in snout-vent length, 10.2 times; top of head flat, the snout rounded in profile, curving back to lip; tip of snout extending .8 mm. beyond lip; nostrils small, the nasal groove directed back and down to the subnarial swelling which is much behind posterior level of nostril; seen from above, snout rounded; interorbital width slightly greater than width of an eyelid; length of eye (1.7 mm.) greater than axial length of snout (1.25 mm.); a

groove, bordering inner edge of eyelids, continuous with the post-orbital groove, which continues back to the nuchal groove, forming an angle where it touches the vertical groove; latter crosses jaw, straight on the sides, but curves back mesially; from this a pair of converging grooves run forward to near tip of chin, but fail to meet; a strong gular fold curves forward across neck, and a short distance up on the sides of neck; from its ends emerges the nuchal groove which curves back then runs up and somewhat forward on the neck to meet its fellow on the median line; a small vertical groove above the median posterior part of the postorbital groove; a groove from mouth angle reaches the first vertical groove; maxillary teeth 19-18; 2 premaxillary teeth piercing the gum; vomerine teeth in two series, on rather thick ridges beginning outside outer level of choanae, curving in and back, separated mesially by a space equal to diastema between two teeth; separated from paravomerine teeth by two and one-half times diameter of a choana; a distinct sublingual fold; paravomerine teeth (in a paratype) in a single patch, notched behind and partly separated posteriorly. All teeth rather brownish in color.

Costal folds, 19; 20 costal grooves, the latter distinct on dorsum, sides, and venter; body skin very smooth, not wrinkled; pits scarcely discernible under a lens; fold formed by the epibranchial cartilage can be traced the width of two costal folds behind level of arm insertion; a white postiliac glandular area; 19th costal groove does not reach below upper level of leg insertion; vent short (1.8 mm.); walls strongly papillate (a small spermatophore present in cloaca).

Arm and leg small, their length equal to 2.5 costal folds, separated by 14 costal folds; four fingers, inner rudimentary; third largest and longest, rather pointed, the tip free; five toes, the second toe rounded; others involved in skin of sole; second and third fingers with little or no web, fused to each other.

Color: Above and on sides dark grayish slate with a narrow median area showing some brownish coloration; ventral coloration gray-brown to grayish, definitely lighter than sides; a cream line hidden by a gular fold; dim cream markings on dorsal surface of thigh and upper arm; a white mark covering postiliac gland; tail colored like body; upper lip with a median light area; limbs lighter than body.

Measurements: (See table).

Remarks: Five specimens were taken, of which four were in rotting logs containing the old burrows of insect larvae. In the same logs were found *Oedipina cyclocauda*. One specimen was found

by R. C. Taylor under a small rock at the edge of a flowing stream.

No. 29968 (tip of tail lost) is brownish, the slaty-gray color not being in evidence. It has, perhaps, recently shed.

MEASUREMENTS AND DATA ON TYPE AND PARATYPES OF *OEDIPINA GRACILIS*

MUSEUM	KUMNH	KUMNH	RCT	RCT	KUMNH
Number.....	29970	29968	1420	1419	29969
Sex.....	♂	♀		♀	♂
Snout to vent (body length).....	41.3	41	41	37	41
Snout to foreleg.....	9.5	9.1	9	8.3	10
Axilla to groin.....	27.5	27.2	27.7	24	27.6
Length to gular fold (head length).....	6.3	6	6.4	6	6.2
Snout to lateral nuchal groove.....	7	7.1	7.4	6.6	7.3
Width of head.....	3.9	4	3.7	3.5	4
Tail length.....	78+	57	105.2	65	107
Arm.....	3.1	4.5	3.9	3	3.4
Leg.....	3	5	4.1	3.6	3.6
Head width in body length.....	10.6	8.2	11	10.3	10
Head length in body length.....	6.45	6.83	6.4	6.16	6.8
Costal grooves.....	20	19	20	20	20
Costal folds.....	19	18	19	19	19
Caudal folds.....	61+	48+	83?	57	86
Maxillary teeth.....	23-22	16-18	21-21	17-18	19-18
Mandibular teeth.....	25-25	38-37	31-31	26-26	27-26
Premaxillary teeth.....	1	3	2	3	2
Vomerine teeth.....	9-10	7-7	9-9	7-8	7-7
Paravomerine teeth (approx.).....	120	120	144	145	?

Oedipina pacificensis sp. nov.

Plate LXXXVII, fig. 2; text fig. 12

Type: Kansas University Museum of Natural History No. 29965 ♀; collected August 23, 1947, about two miles east of San Isidro El General, C. R., at an elevation of approximately 2118 feet, by Edward H. Taylor.

Diagnosis: A species 42.5 mm. snout to vent; tail 77 mm. (regenerated tip); eye length a little less than snout length; costal grooves 19, visible on venter; caudal vertebra 50+; tail rounded for greater part of length, toward tip somewhat compressed; an indefinite depression at base of occiput; maxillary teeth present but reduced in number 12-14; vomerine teeth 8-8; premaxillary teeth 4; paravomerine series with approximately 112 teeth, all on same level; head brown, and a broad brownish stripe from head to base of tail; neck and side gray-slate; limbs light brown, separated when adpressed by 13.5 costal folds; a pair of light spots behind eyelids.

Description of the type: Species of small size for the genus; width of head contained in snout-to-vent length 12.6 times; head length in same distance, 7.4 times; head flat, low, the depth just back of eye 2 mm.; snout narrowed, but not "pointed," there being a very slight medial emargination at tip; nostrils minute, the groove run-

ning from nostril directed backward and downward to the very small subnarial swelling; a distinct groove outlines the inner border of eyelid and continues back from eye to the nuchal groove; back of eye a short distance, a groove arising on side of head crosses the chin and jaw, touches but does not bisect the postorbital groove; the chin groove forms a curve on the mesial half of the chin and two narrow slightly converging grooves run forward from it and terminate near the anterior part of chin; gular fold crosses throat, curving strongly forward; on sides groove continues to near median dorsal line; posterior part of epibranchial cartilage continues above arm to second costal groove (counting an axillary groove); head (3.6 mm.) a little wider than body (3.3 mm.); no groove from nostril directed backward, the loreal area somewhat inflated; snout rounded in lateral profile; top of head strongly pitted and corrugated; glands on head and to a somewhat lesser extent on body, forming minute circular cream spots visible under a lens; eye large, the length 1.8 mm. (free edge of upper lid), 1.25 times axial length of snout (from a line across front of eyes to median tip); width of eyelid in interorbital distance, 1.5 times.

Tongue free (rather far back in mouth), only a rudiment of a sublingual fold present; maxillary teeth present, 12-14, reaching back on side somewhat behind outer end of vomerine series; two, possibly three, premaxillary teeth, separated narrowly from maxillary teeth; vomerine teeth 8-8 in a strongly elevated series arising behind and about level of middle of choanae, running in and curving back somewhat; choanae large, somewhat transversely oval; the diameter of one in distance between them, three times; palatal area in front of vomerine ridges (seen from below) much more elevated than region posterior to the ridges; paravomerine tooth series forming a single patch, slightly notched behind, separated by half length of one vomerine ridge from the vomerine series; total number of paravomerine teeth approximately 112; mandibular teeth 14-14.

Costal grooves 19-19; limbs each equal in length to two folds; when adpressed separated by 13.5 folds; limbs short, the hand about .7 mm. in width bearing four digits; inner digit reduced, the tip not free; third longer than second, free only at tip; fourth much shorter than either second or third, its tip barely free; foot .8 mm. in width with five toes, the third toe longest, the tips of the three median free and rounded; first and fifth short but distinct, the tips not free.

A small postiliac gland present; skin of body smooth or shallowly pitted; lateral costal folds with longitudinal wrinkles; tail sub-circular, now somewhat shrunken; 50 caudal grooves; the terminal part of tail somewhat compressed, with a short, recently regenerated part; no obvious constriction at base of tail.

Color: Head brown with an irregular whitish area back of each eye on dorsal part of head (scarcely discernible in preserved specimen); eyelids blackish; edge of both upper and lower eyelid dimly bordered with dirty white; a whitish, roughly-triangular spot at tip of snout on upper lip; remainder of top and sides of head brownish; a median stripe of brown from head to base of tail; sides and

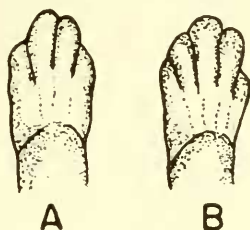


FIG. 12. *Oedipina pacificensis*. Type. A. Left hand, dorsal view. B. Left foot, dorsal view. (Much enlarged.)

tail slate; arms and legs light brown with a white spot on under side at joint, and a whitish spot below insertion of limbs; chin dirty whitish; venter and underside of body grayish slate; a postfemoral white spot covering gland; nuchal groove on throat white.

Measurements in mm.: Snout to end of vent 43; length of tail 77+; snout to fore leg 10; axilla to groin 29; snout to nuchal groove (medial ventral) 6; snout to (lateral) nuchal groove 7; head width, 3.6; eye to nuchal groove (lateral) 5; arm 3.8; leg 4.

Oedipina inusitata sp. nov.

Plate LXXXVII, fig. 3; text fig. 13

Type: Kansas University Museum of Natural History No. 29964 ♀; collected three miles northeast of Santa Cruz, on the southern face of Volcán Turrialba, Costa Rica, at an elevation of approximately 6500 ft., Aug. 9, 1947, by Edward H. Taylor.

Diagnosis: A species, 44.2 mm. from snout to vent, the tail double this length (88.8 mm.); eye as long or longer than snout; snout

blunt; costal grooves 19, not visible on ventral surface; approximately 70 caudal vertebrae, tail flattened below at base, and compressed somewhat toward tip; a deep elongate nuchal pit at base of occiput (presumably normal); skull not strongly ossified (probably largely cartilage); 19-19 maxillary teeth; vomerine teeth 9-4 + on strongly elevated ridges more or less continuous across jaw; paravomerine teeth in two groups, in contact anteriorly, then diverging somewhat; from near the middle of series posterior part strongly deflected downward; combined width $1\frac{1}{2}$ times in total length of the series; general color gray-black above; grayish below.

Description of type: Species of moderate size; width of head (4.1 mm.) contained in snout-to-vent length (44.2 mm.) about 10.7 times; head length (6 mm.) to nuchal groove (medial ventral) in

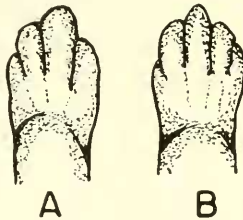


FIG. 13. *Oedipina in-ositata*. Type. A. Right hand, dorsal view. B. Right foot, dorsal view. (Much enlarged.)

same distance 7.3 times; (lateral measurement of head to nuchal groove 7 mm.). Head very slightly wider than body; dorsal portion of head somewhat depressed (due presumably to the poorly ossified condition of the skull); snout blunt, rounded; no groove or depressed area following nostril; snout rounded in lateral profile; top of head strongly pitted, the pits distinct, the skin minutely corrugated; no groove bordering inner edge of eyelids; width of eyelid at least twice in interorbital distance; a groove from eye running back to nuchal groove, bisecting a vertical groove on side of head; latter groove runs across jaw and chin forming an irregular line curving back somewhat mesially; a pair of narrow symmetrical grooves run forward from this line terminating near tip of chin; nuchal fold crosses neck, curving forward medianly, the fold ample; on sides of neck the groove can be traced to median dorsal line; a deep pit, a half millimeter long, at base of occiput with a groove entering from both sides; posterior extension of epibranchial carti-

lage reaches a little behind arm insertion; costal grooves 19, the grooves rather dim, there being little or no trace of the grooves across the venter; over much of body surface skin with fine longitudinal wrinkles; a strongly-defined white glandular spot behind insertion of hind limb; tail slender, not or scarcely constricted at base; under surface with a narrow flattened surface, tail becoming laterally compressed toward tip; tail twice length of head and body. Limbs small, when adpressed, separated by $13\frac{1}{2}$ costal folds; hand with four digits, the third longest, bluntly pointed; second longer than fourth; foot with five digits, the first greatly reduced and scarcely discernible; first, second and third equally broad, the latter longest; the second and fourth equal; fifth toe narrow, a little longer than first; digits free only at extreme tip. Maxillary teeth 19-18; premaxillary teeth 5 in an uneven row; vomerine teeth 9-10; mandibular teeth 23-23; vomerine teeth curving from outer edge of choanae; paravomerine teeth in two slightly separated series touching anteriorly, slightly separated posteriorly, not on same level but just anterior to middle of series strongly deflected; choanae large, the diameter of one contained in distance between the two a little more than three times.

Measurements in mm.: Snout to vent 44.2; length of tail 88.8; snout to foreleg 9; axilla to groin 29.5; width of head 4.1; length of head to nuchal fold (median ventral point) 7.3; length of arm 3.2; length of leg 4.

Color: Above and on sides of body grayish black, the ventral surface of body and tail grayish; top of head brownish, except that eyelids are blackish above with a light area on outer edge; edge of upper lip light brown or cream; chin light cream with some pigmentation forming some small indistinct rounded lighter spots; nuchal groove and fold and an area below arm insertions, cream. On top of head the skin glands are outlined by a dark reticulation.

Remarks: This species, in the unusual character of the paravomerine teeth, the compressed tail, the dorsal nuchal pit, the poorly ossified skull, seems to be separated amply from the other species of the genus.

The type specimen was taken from under a rotting log under which was also found a specimen of a black-and-red leech rolled into a ball and occupying a rounded depression. When placed in the collecting bag the leech seized the salamander almost immediately, causing the salamander to struggle to escape. It was necessary for me to bring about the separation. The type locality

is in cut-over forest near some open fields on the southern slope of Volcán Turrialba at an elevation of approximately 6500 feet.

Oedipina alfaroi Dunn

Oedipina alfaroi Dunn, Proc. Biol. Soc. Washington, vol. 34, 1921, p. 145 (type locality, Zent, Costa Rica, E. R. Dunn coll.); Taylor, Univ. Kansas Sci. Bull., vol. 30, pt. 1, May 15, 1944, pp. 226-227.

Oedipus alfaroi Dunn, Field Mus. Zool. Ser. vol. 12, 1924, p. 99; The Salamanders of the Family Plethodontidae. Smith College Publ., 1926, pp. 435-436, fig. 86.

Diagnosis: An elongate form with 20 costal grooves; eye proportionally small, distinctly shorter than the snout; teeth absent on maxilla; one premaxillary tooth; limbs short, separated by a distance equal to length of 14 costal folds.

Description: (Museum Comp. Zool. Harvard No. 6938, type.) Elongate body, the head not or scarcely equal to width of body; eye proportionally small, its length (1.2 mm.) distinctly less than snout length (2 mm.); snout oval rather bluntly pointed; posterior ends of eyelids fitting under a diagonal fold; groove from eye to lateral gular fold very indistinct or absent anteriorly; a groove crossing jaw and passing under chin to opposite side; a pair of lines running forward from this on chin to form an incomplete arch; the gular fold curves forward on neck, the groove lacking pigment; head width approximately 12 times in snout-to-vent length; head length 7 times in same distance. Twenty grooves on body; 19 costal folds; at least 63 caudal folds on complete tail; arm and leg slender, the digits united with only tips of two inner fingers and three inner toes free; when limbs are adpressed they are separated by 14 costal folds; tail not or very indistinctly constricted at base, circular in cross section; vomerine teeth in two series of about 9 teeth each, beginning at outer level of choanae and curving back; the series separated from each other by a distance equal to diameter of choana; paravomerine teeth in a single patch; no maxillary teeth; one premaxillary tooth not penetrating the lip; mandibular tooth series present on front half of jaw; a small glandular spot behind insertion of hind limb. Skin very smooth above, the pits not distinct; a small sublingual fold.

Color: Above rather lavender to purplish brown, light grayish below; postiliac glandular spot whitish.

Measurements in mm.: Snout to end of vent, 61; head width, 5.1; head length to gular fold, 7.5; tail (regenerated), 43.5; arm, 4; leg, 4.6.

Remarks: I have examined the type and paratype from Zent and a specimen from Suretka. The latter specimen has a tail length of 104 mm., and a snout-to-vent length of 54.5 mm., slightly more than half of the tail length.

The relationship of this species is with *Oedipina elongatus* Schmidt from Guatemala and Chiapas.

CAECILIANS

ORDER GYMNOPIHONA Müller

Gymnophiona Müller, Zeitschr. Physiol., vol. 4, 1832, p. 24.

FAMILY CAECILIIDAE Gray

Caeciliidae Gray, Ann. Philos., ser. 2, vol. 10, 1825, p. 217.

Two genera, *Dermophis* and *Gymnopsis*, are recognized in Costa Rica.

KEY TO GENERA OF COSTA RICAN CAECILIIDAE

1. An eye present; without an inner row of mandibular teeth, *Dermophis*
 No eye; an inner mandibular tooth row *Gymnopsis*

Animals belonging to the Gymnophiona bear a striking resemblance to earthworms. They lack limbs and in color are usually dark lead, slate or occasionally lavender. They are commonly called caecilians.

Genus DERMOPHIS Peters

Dermophis Peters, Monatsb. Akad. Wiss. Berlin, 1879, pp. 930, 937.

Type of genus: *Siphonops mexicanus* Duméril, Bibron and Duméril.

Only a single form of this genus is known to occur in Costa Rica.

Dermophis mexicanus gracilior Günther

Plate LXXXVIII

Dermophis gracilior Günther, Biología Centrali-Americana: Reptilia and Batrachia, Jan. 1902, p. 306, pl. 76, fig. B (Chiriquí, Panamá); Nieden, Das Tierreich, Gymnophiona, 1913, p. 9.

Dermophis mexicanus gracilior Dunn, Proc. New England Zool. Club, vol. 10, p. 73; Bull. Mus. Comp. Zool. Harvard Coll., vol. 91, Dec. 1942, pp. 447-478 (Poza Azul, Costa Rica. Also Panamá records).

The following described specimen from San Isidro El General has been referred to this form with some hesitation, since it differs in several points from the published data on *gracilior*. Since the specimen is young, the discernible color characters, and those of the skin glands may be those of youth. The reduced number of primaries and secondaries is approached by a specimen listed

by Dunn (1944). Sufficient Costa Rican specimens may warrant the placing of these in another subspecies.

Diagnosis: Eyes distinct, tentacle closer to eye than nostril; 93 primaries (not counting nuchal grooves), the first 47 lacking secondaries; 49 secondaries; no inner mandibular teeth present; a deep short secondary groove on first nuchal fold, and another shallow

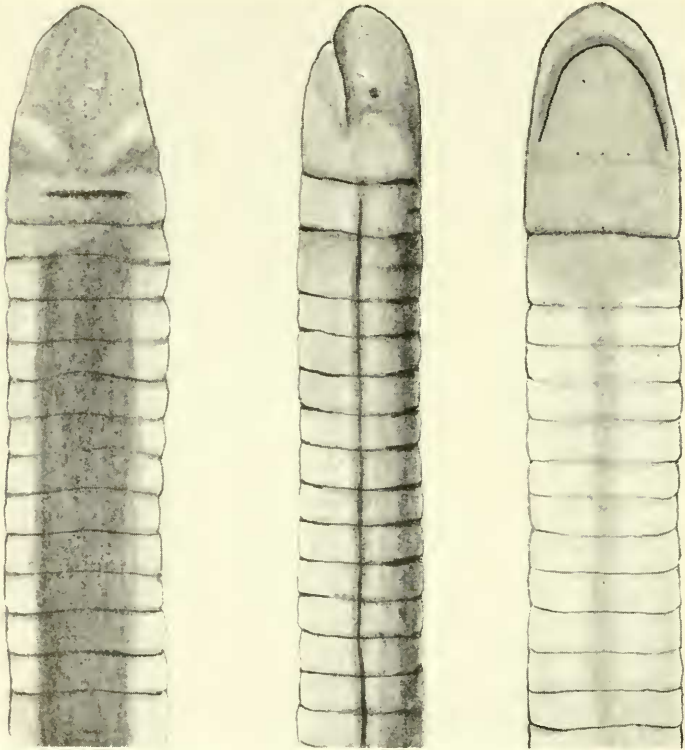


PLATE LXXXVIII. *Dermophis mexicanus gracilior* Günther. K.U.M.N.H. No. 29979. San Isidro El General, Costa Rica. Width of head, 6 mm.

groove on the second fold; total length, 160.5 mm.; a broad dorsal stripe of purplish lavender, darker dorsolaterally on outer edges; this bordered anteriorly by a narrow light lavender stripe; below clouded with lavender on a cream ground-color.

Description of subspecies: (K.U.M.N.H. No. 29979). Body moderately thick, the general width of body (8 mm.) in total length (161.5 mm.) about 20 times; snout subconical; eye visible, its lower edge about 1.15 mm. above edge of lip and 3.5 mm. from tip of

snout; tentacle surrounded by a circular groove closer to eye than to nostril; maxillary-premaxillary tooth row continuous, with total of 30 teeth, curving slightly back, those in the premaxillary part of series a little larger than others; prevomerine-palatine series of approximately 40 very small teeth; outer mandibular row of 26 teeth, very unequal in size, teeth diminishing toward posterior part of the series, the teeth larger than those in maxillary series; no inner mandibular teeth; choanae moderate, their anterior edges about 1 mm. behind the front end of prevomerine tooth series. Inner part of mouth in area between the upper tooth rows and in region anterior to choanae, with small dark punctations: also some punctations around the choanae and on the sides of the palate (probably small glands). First two annular folds differ from those on body; first groove curving a little on dorsal surface is slightly farther forward on venter than above; the second groove corresponding to the nuchal and gular fold (or groove) of salamanders is deeper than the preceding; third annular groove moderately distinct. Width of the two nuchal folds is 2.7 mm. and 3.2 mm. respectively; there are two secondary grooves on these folds, the first short and deep on middorsal surface, the second not deep but distinct on dorsum and sides; on each side in front of first groove two small moundlike elevations, separated mesially. The first 47 body primaries lack secondaries; total primaries 93; total secondaries 46 (22 of which encircle the body); vent with edges swollen and 6 denticulations on each border.

Color: The dorsal coloration consists of a broad purplish lavender stripe darker on dorsolateral edges, sharply delimited; each side of this bordered by a narrow discrete light lavender stripe anteriorly, below which the color is dirty cream, clouded with some sparse lavender pigment. This is continued on to venter, which is dull cream near the middle, almost without pigment; anal region and area about the tentacle, cream white; chin and throat grayish anteriorly; beginning near neck and continuing an indefinite distance; there is a median narrow ventral dark line.

Measurements in mm.: Snout to vent 159; vent to end of body 1.5; width of head at first groove 6; widest part of neck 6.6; distance between tentacle and nostril 1.9; between tentacle and corner of mouth 3.9; tentacle from eye 1.5; distance from eye to nostril 4; nostril from snout tip 1; nostril from edge of lip 1.9; 1st groove from tip of chin 5.2; 1st groove to end of snout 7; from end of second fold to tip of snout (ventral) 13.

Remarks: A distinctive character of this form is the presence of the greatly enlarged skin glands following the lines of the primaries and likewise of the secondaries. These are evident externally to the naked eye as small subcircular depressions almost contiguous, and by the yellow or cream color of the glands. In size these are five or six times larger than the other skin glands. They are visible under a lens as small cream or white punctations in a fine reticulum of lavender. On the ventral surface the glands are visible but the lavender reticulum may be entirely wanting, or a very sparse amount may be present in patches. Whether or not the character of the glands is comparable to those, in *Dermophis mexicanus clarki*, *Dermophis parviceps* and in the adults of *gracilior*, I do not know since these forms have been inadequately described.

Genus GYMNOPIIS Peters

Gymnopsis Peters, Monatsb. Akad. Wiss. Berlin, 1874, p. 616.

Type of genus: *Gymnopsis multiplicata* Peters.

Two forms, here treated as subspecies, are known to occur in Costa Rica.

KEY TO COSTA RICAN GYMNOPIIS

Primaries 112-126; secondaries 84-104 *multiplicata proxima*
 Primaries 128-132; secondaries 101-111 *multiplicata multiplicata*

Gymnopsis multiplicata multiplicata Peters

Gymnopsis multiplicata Peters, Monatsb, Akad. Wiss. Berlin, 1874, p. 616, pl. 1, fig. 1 (type locality, Veragua, collected by von Warszewicz); *idem*, 1879, p. 939, fig. 7; Boulenger (*part.*), Catalogue of the Batrachia Gradientia s. Caudata and Batrachia Apoda in the collection of the British Museum, 2nd ed., 1882, p. 100; Proc. Zool. Soc. London, 1895, p. 410; Cope, Proc. Amer. Philos. Soc., vol. 22, p. 171; Günther, Biologia Centrali-Americana; Reptilia and Batrachia, Jan. 1902, p. 308; Nieden, Das Tierreich, Gymnophiona, 1913, p. 21; Dunn, (*part.*), Proc. New England Zool. Club, vol. 10, 1928, p. 75. *Siphonops simus* Cope, Proc. Amer. Philos. Soc., vol. 17, 1877, p. 91 (type locality, Costa Rica). *Gymnopsis sina* Cope, Proc. Amer. Philos. Soc., vol. 22, 1885, p. 171; U. S. Nat. Mus. Bull., No. 32, 1887, p. 9.

Diagnosis: Large species, the greatest known total length 510 mm.; body width in total length 25 to 35 times; eye invisible; maxillary-premaxillary tooth series approximately 40; palatine-prevo-merine tooth series approximately 42; outer mandibular series approximately 32 teeth; inner mandibular tooth series, 2. Primary costal grooves on body 132 (not counting grooves on neck), 18 lacking secondary grooves; 114 secondaries, of which only about 15 surround the body completely. Color plumbeous above, the grooves distinctly lighter; venter lighter, gray-lavender.

Description of subspecies: (R.C.T. No. 970). Body elongate, the total length 390 mm.; width of body in total length 32 times; snout oval; eye invisible; tentacle surrounded by a circular groove, the surrounding swollen area three times diameter of opening, situated 4.4 mm. from nostril, 4 mm. from corner of mouth; nostril 1 mm. from tip of snout; maxillary-premaxillary teeth in a nearly continuous series of about 40, the most posterior smallest; palatine-prevomerine series with approximately 42 teeth; area between these tooth series as well as the region anterior to choanae and on sides of palate back of choanae, showing fine darker punctations which probably are glands; outer mandibular tooth row with 32 teeth, larger than the maxillary teeth on the whole, but posterior ones of the series about the size of the posterior teeth above; 2 curving teeth in inner mandibular series.

First annular groove curves farther forward above and below than on sides; slight elevations (glandular) on each side in front of first groove, not meeting mesially; second groove, transverse straight; third groove marking limit of second fold curves back on throat and is incomplete ventrally; ventral width of first and second folds 4.8 mm. and 6 mm. respectively; primary body grooves 132, 18 without secondaries; 114 secondaries, the terminal 15 completely surround body; vent transverse with two lobules on front border, eight on lateral and posterior borders.

Color: Above dark plumbeous slate, the grooves light gray, at least on anterior part of body; ventral parts dark tending to lavender near middle of body; a cream spot at vent and another behind and including the tentacle.

Measurements in mm. of Nos. 970, 29978: Snout to vent 382, 164; vent to end of body 3, 1.5; width of head at first groove 10.5, 6.4; greatest width of neck 12, 6.8; tentacle from nostril 4.5, 2.6; tentacle from corner of mouth 4, 2.5; tentacle from tip of snout 5.5, 3.2; nostril from tip of snout 1.8, .8; tip of snout to first annular groove 11, 6.1; tip of snout to second annular groove 15, 10; tip of snout to end of second fold (first body groove) 21.

Variation: The specimen differs from the type in being plumbeous-slate rather than black in coloration. A second specimen (K.U.M.N.H. No. 971), taken in the same immediate vicinity, differs but little save in size. It measures 164 mm., its width (6 mm.) in length, 27.3 times. The primaries and secondaries are very similar in number, there being respectively 133 primary body grooves and 113 secondaries. Average counts of specimens listed by Dunn (1942) for Costa Rica show the following range and

averages for primaries and secondaries respectively: 128-132, average 129; 101-110, average 106. It will be noted that the specimens have a somewhat higher average of both primaries and secondaries, but of a magnitude scarcely significant.

Variation in dentition is more significant and one concludes that teeth are added as the animal grows older and larger. The smaller specimen (K.U.M.N.H. No. 29978) has fewer teeth in the maxillary-premaxillary series (21) but if one counts the diastemata there are spaces for 31 teeth. One presumes that the later additions are made on the posterior part of the series. The palatine-prevomerine series has approximately 32 teeth, the outer mandibular series 24, and the inner mandibular series 2. In color the young is similar to the adult, with the gray lines marking the anterior grooves.

The species has been reported from the following Costa Rican localities: Tilaran, San Mateo, and Taboga. The two specimens here listed are from three miles north of San Isidro El General. They were taken from under rocks in a wet meadow.

Gymnopsis multiplicata proxima (Cope)

Text fig. 14

- Siphonops mexicanus* Cope, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, 1875, p. 96 (eastern Costa Rica).
Siphonops proximus Cope, Proc. Amer. Philos. Soc., vol. 17, 1877, p. 90 (type locality, eastern Costa Rica; Wm. Gabb coll.).
Dermophis ? *proximus* Peters, Monatsb. Akad. Wiss. Berlin, 1879, p. 938; Boulenger, Catalogue of the Batrachia Gradientia s. Caudata and Batrachia Apoda in the Collection of the British Museum, 2nd ed., 1882, p. 99.
Gymnopsis proxima Cope, Amer. Philos. Soc., vol. 22, 1885, p. 171; U. S. Nat. Mus. Bull. No. 32, 1887, p. 9; Boulenger, Proc. Zool. Soc. London, 1895, p. 410; Günther, Biologia Centrali-Americana; Reptilia and Batrachia, Jan. 1902, p. 308; Nieden, Das Tierreich, Gymnophiona, 1913, p. 21; Noble, Bull. Amer. Mus. Nat. Hist., vol. 38, 1918, p. 346.
Gymnopsis multiplicata (part.), Dunn, Proc. New England Zool. Club., vol. 10, 1928, p. 75; Bull. Mus. Comp. Zool. Harvard College, vol. 91, 1942, pp. 466-468.

Diagnosis: A large form, reaching a known maximum length of 480 mm.; eye invisible; tentacle in a circular groove, widely separated from nostril; maxillary-premaxillary tooth series (total) 50; approximately 40 mandibular teeth, larger than the upper series; approximately 60 teeth in the prevomerine-palatine series; 6 teeth in the inner mandibular series; primaries 112 to 126; secondaries 84 to 104. Gray lavender above and on sides; dirty yellowish white below; area about vent cream; tentacle and region posterior to eye dull cream.

Description of subspecies: (K.U.M.N.H. No. 29977 ♀, Turrialba, adult female). Large, the snout to vent length 405 mm.; body width (18 mm.) in length 22.5 times; eye invisible; tentacle surrounded by a circular groove, situated nearly midway between angle of mouth and nostril; nostril 2 mm. from tip of snout; maxillary-premaxillary teeth in a continuous row containing a total of 50 teeth; teeth of the palatine-prevomerine series continuous, the teeth very small (save for a single, large anomalous tooth on one side) the number of teeth being approximately 60; outer mandibular teeth total approximately 40, varying in size, the smaller

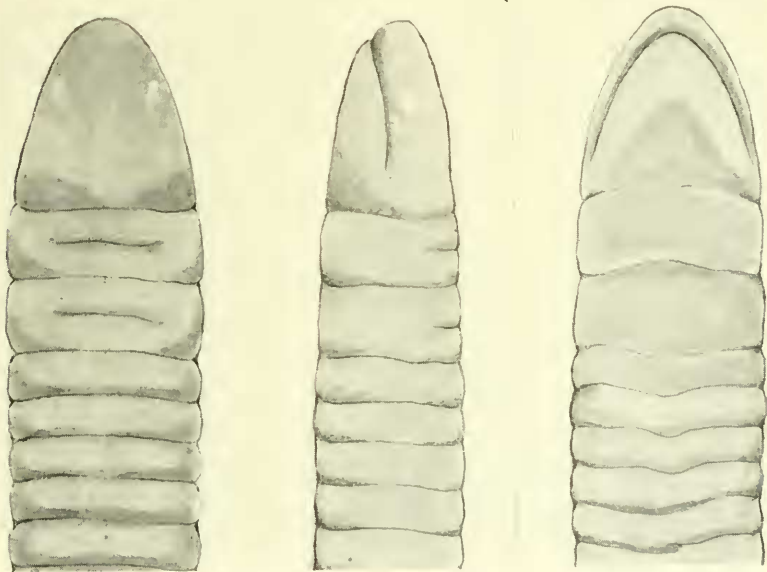


FIG. 14. *Gymnopsis multiplicata proxima* (Cope) K.U.M.N.H. No. 29977, Turrialba, Costa Rica. Width of head, 14 mm.

teeth much larger than those in the maxillary-premaxillary series; 6 teeth in the inner mandibular series the teeth contiguous on each side with a slight median diastema. Choanal openings rather elongate, 3 mm. from anterior prevomerine teeth; some pigment discernible between the upper rows of teeth.

First annular fold on back of head complete curving forward dorsally and a little farther forward on chin; second groove transverse, the groove limiting the second fold not complete on ventral surface; width (ventral) of first two folds, 5 mm. and 7.5 mm. re-

spectively; there are secondary grooves on both folds confined to dorsal surface; primary body grooves $22 + 98$; secondary grooves 98; only the last ten completely surround body; preceding first neck fold are two very slight elevations dorsolaterally, not meeting mesially.

Skin glands in adult not visible through the skin; vent with 8 posterior denticulations on sides and posterior edge; two large lobules on anterior edge.

Color: In life there was a grayish ultramarine cast on dorsal and lateral surfaces, the venter dull dirty cream; tentacle and an area behind it, cream; an area about vent cream.

Measurements in mm.: Snout to vent 402.2; vent to end of body 2.8; width of head at first groove 14; greatest width of neck 14.8; width of body 18; tentacle to end of snout 7; nostril to end of snout 2; first groove to tip of snout (ventral) 12.6; to second groove 18; to first annular body groove 25.

Variation: Two small specimens (R. C. T. Nos. 331-332) are at hand. The first was found with the larger No. 29977, the second was taken from the uterus. They measure 131 and 128 mm. in length respectively. The top of the head is darker, the color coming to a point behind on middorsal line at the first groove. The body is lavender-slate, distinctly lighter below. In these, the skin glands are visible under a lens. On the first two folds certain larger glands are thickly scattered. At succeeding grooves there is a regular transverse line of larger grooves visible under the lens. These can be traced around the body with occasional interruptions; they occur also in the secondary grooves. The characteristic grooves forming the lobules or denticulations about the vent are evident in the two young.

Dunn (1942) lists numerous specimens from various localities in Panamá, Costa Rica, and Nicaragua. The variation in the primaries and secondaries for the three countries is as follows:

Panamá 115-125; 85-101; average 118.5, 94.

Costa Rica, 112-124; 84-104; average 119, 93.5.

Nicaragua, 118-126; 95-103; average 121, 98.

Costa Rican localities for this subspecies are: Suretka, Limón, Monteverde, Reventazón, Guápiles, Cariblanco, Peralta, Parismina and 5 km. north of Cartago. Specimens reported in this paper are from Turrialba. They were found in a pile of rocks.

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